

AD-A194 617

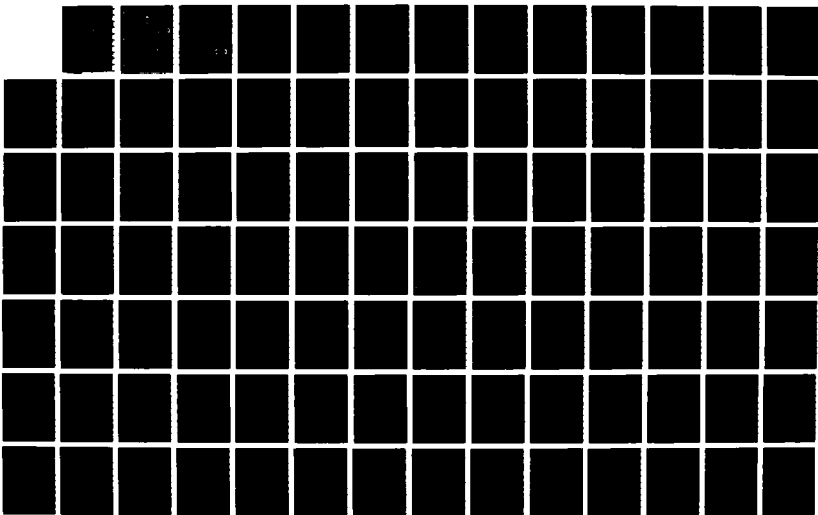
USING ORIGEN2 TO PREDICT NUCLEAR REACTOR FUEL
COMPOSITIONS(U) AIR FORCE INST OF TECH WRIGHT-PATTERSON
AFB OH SCHOOL OF ENGINEERING B A LINDBLOH MAR 88
AFIT/GNE/ENP/88H-6

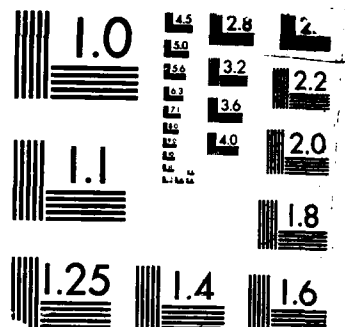
1/2

UNCLASSIFIED

F/G 18/10

NL





MICROCOPY RESOLUTION TEST CHART
NBS 1963-A

AD-A194 617



DTIC
ELECTE
JUN 23 1988
S H D

USING ORIGEN2 TO PREDICT
NUCLEAR REACTOR FUEL COMPOSITIONS
THESIS

Bruce A. Lindblom
Captain, USAF

AFIT/GNE/ENP/88M-6



DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY
AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

DISTRIBUTION STATEMENT A

Approved for public release;
Distribution Unlimited

88 6 23 04 c

1

①

AFIT/GNE/ENP/88M-6

USING ORIGEN2 TO PREDICT
NUCLEAR REACTOR FUEL COMPOSITIONS
THESIS

Bruce A. Lindblom
Captain, USAF
AFIT/GNE/ENP/88M-6

DTIC
ELECTE
JUN 23 1988
S D
CCH

Approved for public release; distribution unlimited

AFIT/GNE/ENP/88M-6

**USING ORIGEN2 TO PREDICT
NUCLEAR REACTOR FUEL COMPOSITIONS**

THESIS

Presented to the Faculty of the School of Engineering
of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the
Requirements for the Degree of
Master of Science in Nuclear Science

Bruce A. Lindblom, B.S.

Captain, USAF

March 1988

Approved for public release; distribution unlimited

Preface

As with many theses conducted at the Air Force Institute of Technology (AFIT), this thesis concerns a contemporary Air Force interest--the generation of a data base of nuclear reactor fuel compositions using the ORIGEN2 Isotope Generation and Depletion Code. Dr. Marcel Kniedler of the Air Force Technical Applications Center (AFTAC) proposed that an AFIT student undertake this project, and Lt Col Ronald Tuttle, Deputy Head of the AFIT Engineering Physics Department, agreed to act as the faculty advisor for such a study. Lt Col Tuttle's previous experience as an officer assigned to AFTAC Headquarters proved invaluable in translating the current desires of AFTAC into a thesis topic suitable for a Master of Science candidate.

Any undertaking of this nature inevitably leads to certain pitfalls and dead ends. A number of individuals deserve acknowledgments for their part in minimizing these hindrances. I am indebted to Lt Col Tuttle for his continued guidance and ready assistance whenever a seemingly insurmountable problem was encountered. Mr. Scott Ludwig at the Oak Ridge National Laboratory was instrumental in helping me to grasp the nuances and peculiarities of the ORIGEN2 code. Maj James Lupo, Engineering Physics Department, and Mr. Mark Petre, AFIT Computer Consultant, were also quite helpful in solving system-related problems pertaining to this project. LCDR Kirk Mathews joined Lt Col Tuttle and Maj Lupo to form my faculty committee, offering many insightful comments and suggestions for improvement. Lastly, I would like to thank my wife, Kathy, and our children for their understanding and patience with me during these last several months.

Bruce A. Lindblom



For	
&I	<input checked="checked" type="checkbox"/>
ed	<input type="checkbox"/>
tion	<input type="checkbox"/>
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	

Table of Contents

	Page
Preface	ii
List of Figures	v
List of Tables	vi
Abstract	vii
I. Introduction	1
Background	1
The ORIGEN2 Code	2
Purpose and Scope	3
II. Description of ORIGEN2	5
Input Data	5
Calculations	7
Output Data	11
III. Modifications Made to the Code	13
IV. Description of the ORIGEN2 Command File	16
V. Cases Run	20
PWR, 33 GWd/MTIHM	20
PWR, 50 GWd/MTIHM	21
BWR, 27.5 GWd/MTIHM	21
CANDU, 7.5 GWd/MTIHM	22
CANDU, 20.9 GWd/MTIHM	23

	Page
LMFBR - Core, 100 GWd/MTIHM	23
LMFBR - Axial Blanket, 100 GWd/MTIHM	24
LMFBR - Radial Blanket, 100 GWd/MTIHM	24
VI. Results	26
Illustrative Plots	26
Conversion of Fractional Gram-atoms to Grams	33
VII. Conclusion	35
Appendix A: PWR, 33 GWd/MTIHM	37
Appendix B: PWR, 50 GWd/MTIHM	43
Appendix C: BWR, 27.5 GWd/MTIHM	49
Appendix D: CANDU, 7.5 GWd/MTIHM	55
Appendix E: CANDU, 20.9 GWd/MTIHM	61
Appendix F: LMFBR - Core, 100 GWd/MTIHM	67
Appendix G: LMFBR - Axial Blanket, 100 GWd/MTIHM	73
Appendix H: LMFBR - Radial Blanket, 100 GWd/MTIHM	79
Appendix I: Verification Testing	85
Appendix J: Running ORIGEN2 on the AFIT SSC	92
Bibliography	95
Vita	96

List of Figures

Figure	Page
1. Sample ORIGEN2 Command File	17
2. Fission Product Compositions - 270 days	27
3. Fission Product Compositions - 720 days	28
4. Actinide Compositions - 270 days	29
5. Actinide Compositions (without LMFBR case) - 270 days	30
6. Actinide Compositions - 720 days	31
7. Actinide Compositions (without LMFBR case) - 720 days	32

List of Tables

Table	Page
1. QQPACK Verification	15

Abstract

The purpose of this study was threefold: (1) to modify the ORIGEN2 Isotope Generation and Depletion Code to run on a Digital VAX computer using a UNIX operating system, (2) to establish a data base of nuclear reactor fuel isotopic compositions for selected reactor types and fuel cycles at various times during each fuel cycle, and (3) to determine the uniqueness of the isotopic compositions of the cases studied. The ORIGEN2 code uses a matrix exponential technique to solve the differential equations describing the buildup and decay of nuclides. The user-generated command file and the highly controllable output make ORIGEN2 quite versatile in modeling reactor operations. Modifications required to allow the code to run on a UNIX-based Digital VAX system were confined primarily to one of the integer functions used in reading the command file. Actinide and fission product compositions of irradiated fuel were produced for eight cases representative of modern commercial nuclear reactors. These results include composition by both isotope and element and are expressed in fraction of atoms of each segment (actinide or fission product). Isotopic fuel compositions were shown to be distinctly unique.

USING ORIGEN2 TO PREDICT NUCLEAR REACTOR FUEL COMPOSITIONS

I. Introduction

Background

The Air Force Technical Applications Center (AFTAC) operates and maintains the U.S. Atomic Energy Detection System (AEDS). The AEDS is a worldwide system with operations in thirty-five countries. When the Limited Test-Ban Treaty was signed in 1963, the primary role of monitoring certain provisions of the treaty, mainly Safeguard D, was assigned to AFTAC. AFTAC efforts involve comprehensive research and development programs associated with the detection and identification of nuclear events in the atmosphere, underground, underwater, and in space. The Center provides inputs to Department of Defense policies regarding arms-control issues and contributes to the nation's ability to monitor international agreements in these areas (7:1).

The Soviet nuclear reactor accident at Chernobyl on April 26, 1986, illustrates the importance of being able to determine the origin of a given radioactive sample. Although an estimated 81 million curies of radioactivity were released to the atmosphere in this incident, the Soviet government did not acknowledge that an accident had occurred until May 14, almost three weeks after the fact (8:379,380). For treaty monitoring reasons, it is absolutely essential that AFTAC have the capability to distinguish between reactor releases and nuclear weapon debris. This thesis is designed to be a first step in the compilation of a comprehensive data base of nuclear reactor fuel compositions versus time for various reactor types and fuel cycles. The ORIGEN2 computer code is the tool used

to generate this initial data set.

The ORIGEN2 Code

ORIGEN2 is a versatile reactor physics code which simulates various nuclear reactor fuel cycles and calculates the isotopic composition and characteristics of the irradiated fuel and other materials within the reactor. The original ORIGEN code was written by Bell and Nichols at the Oak Ridge National Laboratory (ORNL) and distributed worldwide beginning in the early 1970s (2:335-336). The revised and updated ORIGEN2 includes provisions for incorporating data generated by more sophisticated reactor physics codes, a free-format input, and a flexible and highly controllable output.

The data libraries accompanying the ORIGEN2 code allow modeling of four different types of reactors--pressurized water reactors, boiling water reactors, liquid-metal fast breeder reactors, and Canada deuterium uranium reactors. Currently, thirty-nine different reactor fuel cycles can be simulated using the above four reactor types. Although the principal use of ORIGEN2 is to calculate the isotopic composition of nuclear materials, the following parameters may also be computed with ORIGEN2 (2:336-337):

- Radioactivity
- Thermal power
- Toxicity (radioactive and chemical)
- Neutron absorption rate
- Neutron emission rate
- Photon emission rate
- Fission rate

When the original ORIGEN code was released, about 200 organizations acquired it through the ORNL Radiation and Shielding Information Center. Since

ORIGEN2's release in September 1980, it has been acquired by 110 organizations (2:336). ORIGEN2 is written entirely in FORTRAN and was designed to run on an IBM 360, 370, or 3033 computer. It has been modified to run on other types of computers, including the Digital VAX 11/780 with VMS operating system. To run ORIGEN2 on the AFIT Scientific Support Computer (SSC), which is a VAX 11/785 with UNIX operating system, further modifications were made which are explained in Section III.

Purpose and Scope

The purpose of this project was threefold: (1) To get the ORIGEN2 code running on the SSC, (2) to establish a data base of reactor fuel isotopic compositions for selected reactor types and fuel cycles at various times during each fuel cycle, and (3) to determine the uniqueness of these isotopic compositions. Only the actinides and fission products have been considered. The effects experienced by the other reactor materials (fuel impurities, cladding, moderator, etc.) are assumed not to affect the actinide and fission product inventories contained inside each fuel element. Each case assumes a full load of fresh fuel at start-up and tracks the change in isotopic composition while the fuel is being irradiated within the reactor. Following is a list of the cases studied in this thesis:

- (1) Pressurized water reactor, 33 gigawatt-days/metric ton of initial heavy metal
- (2) Pressurized water reactor, 50 gigawatt-days/metric ton of initial heavy metal
- (3) Boiling water reactor, 27.5 gigawatt-days/metric ton of initial heavy metal
- (4) Canada deuterium uranium reactor, 7.5 gigawatt-days/metric ton of initial heavy metal
- (5) Canada deuterium uranium reactor, 20.9 gigawatt-days/metric ton of initial heavy metal

- (6) Liquid-metal fast breeder reactor (core), 100 gigawatt-days/metric ton of initial heavy metal
- (7) Liquid-metal fast breeder reactor (axial blanket), 100 gigawatt-days/metric ton of initial heavy metal
- (8) Liquid-metal fast breeder reactor (radial blanket), 100 gigawatt-days/metric ton of initial heavy metal

The term "initial heavy metal" refers to the fissile and fertile actinide content of the unirradiated fuel, primarily uranium and plutonium. For more detailed information about each of the above cases (type of fuel used, number of full-power days, etc.), refer to Section V.

II. Description of ORIGEN2

Input Data

Three principal types of input data bases are required by ORIGEN2: radioactive decay, photon production, and cross section (includes fission product yields). In general, the same decay and photon data bases can be used for virtually all cases that would ever be considered. This is not true, however, for the cross section data. The effective cross sections of all nuclides, especially the actinides, are a strong function of reactor type and nuclide concentration (2:338). These effects can only be predicted through the use of more sophisticated reactor physics codes, and it is by means of such codes that the cross section libraries supplied with ORIGEN2 were produced. Another required input file is the user-constructed set of ORIGEN2 commands that defines which program functions are to be executed and the order of their execution. The first three input files are discussed in the following paragraphs with a more detailed explanation of the ORIGEN2 command file appearing in Section IV.

The decay data base was constructed from the *Table of Isotopes*, 6th ed., by Lederer *et al.* (2:336) and provides the following calculational information:

- (1) the list of 1700 nuclides to be considered
- (2) the decay half-lives and decay branching fractions for beta decay to ground and excited states, positron/electron annihilation to ground and excited states, internal transitions, alpha decay, spontaneous fission, and delayed neutron decay
- (3) the recoverable heat per decay for each radioactive parent
- (4) the isotopic compositions of naturally occurring elements

- (5) the radionuclide maximum permissible concentration values as specified in the *U.S. Code of Federal Regulations*, Title 10, Part 20.

A six-digit nuclide identifier defines each of the nuclides in the decay library.

The nuclide identifier is defined as

$$\text{NUCLID} = 10,000 \times Z + 10 \times A + \text{IS}$$

where

NUCLID = six-digit nuclide identifier

Z = atomic number of nuclide (1 to 99)

A = atomic mass of nuclide (integer)

IS = isomeric state indicator, where 0 = ground state and
1 = excited state

The six-digit identifier for an element is similarly defined:

$$\text{ELEMID} = 10,000 \times Z$$

where ELEMID is the element identifier and Z is the atomic number. In cases of atomic number less than 10, a leading zero is not required, thus resulting in a nuclide or element identifier with only five digits (1:11,13).

The photon data library provides the number of photons produced per decay, divided into 18 energy-groups. Types of photons included are gamma rays, x-rays, conversion photons, (α, n) gamma rays, prompt and fission product gamma rays from spontaneous fission, and bremsstrahlung. Not included are prompt gamma rays from fission and neutron capture. The data for this library comes from ORNL-5054. The photon production library is used to generate an output table listing the number of photons and the photon energy emission as a function

of irradiation time or decay time. A summary table is also created, giving the principal nuclide contributors to each energy-group (2:343).

The purpose of the cross section library is to supply effective one-group cross sections for all the nuclides and fission product yields for Th^{232} , U^{233} , U^{235} , U^{238} , Pu^{239} , Pu^{241} , Cm^{245} , and Cf^{252} . Calculation of the one-group cross sections is a complex process that is dependent on the fuel and reactor type being modeled and is accomplished by other reactor physics codes. Types of cross sections normally included in this library are (n,γ) and $(n,2n)$ to ground and excited states, $(n,3n)$ and $(n,\text{fission})$ for the actinides, and (n,p) and (n,α) for the activation and fission products (2:343). The fission yields included are generally from binary fission, although ternary fission yields have been provided for certain important low- Z nuclides (1:66).

Calculations

To determine the isotopic composition of a fuel sample after irradiation, ORIGEN2 uses a matrix exponential method to solve the following nonhomogeneous, first-order, ordinary differential equation:

$$\frac{dX_i}{dt} = \sum_{j=1}^N l_{ij} \lambda_j X_j + \phi \sum_{k=1}^N f_{ik} \sigma_k X_k - (\lambda_i + \phi \sigma_i + r_i) X_i + F_i \quad (1)$$

where

$\frac{dX_i}{dt}$ = the rate at which the amount of nuclide i
changes as a function of time

X_i = atom density of nuclide i

N = number of nuclides

l_{ij} = fraction of radioactive disintegration by
other nuclides which leads to formation of
species i

λ_i = radioactive decay constant

ϕ = position- and energy-averaged neutron flux

f_{ik} = fraction of neutron absorption by other
nuclides which leads to formation of species i

σ_k = spectrum-averaged neutron absorption
cross-section of nuclide k

r_i = continuous removal rate of nuclide i
from the system

F_i = continuous feed rate of nuclide i

Since N nuclides are being considered, N equations of the same general form must be solved to yield the amounts of each nuclide, X_i , at the end of each time step (2:339-340).

It is theoretically possible for each nuclide described by Eq (1) to be produced by all of the other ($N - 1$) nuclides in the system. Fortunately, the average number of parents is usually less than 12. Thus, at least 1688 of the coefficients of X_j on the right side of Eq (1) would be zero, resulting in an extremely sparse 1700 by 1700 coefficient matrix. Because of the sparseness of this matrix, ORIGEN2 is able to use indexing techniques that store only the nonzero elements, thereby greatly reducing the amount of storage capacity required. These indexing techniques produce an array of transformation rates of each parent to daughter nuclide X_i , called the transition matrix (2:340).

The neutron flux in Eq (1) is calculated from

$$\phi = \frac{(6.242 \times 10^{18}) (P)}{\sum_i X_i^f \sigma_i^f R_i} \quad (2)$$

where

ϕ = instantaneous neutron flux

P = power in MW

X_i^f = amount of fissile nuclide i in fuel

σ_i^f = microscopic fission cross section for
nuclide i

R_i = recoverable energy per fission for
nuclide i in MeV/fission

Since the amount of fissile nuclide i present is known only at the beginning of the time step, Eq (2) gives the neutron flux at the beginning of the time step, rather than the average neutron flux, which is the desired parameter. ORIGEN2 overcomes this problem by expanding Eq (2) in a Taylor series through the second-order terms with X_i^f as the time-dependent variable. The average neutron flux is then obtained by integrating this expansion over the time step and then dividing by the length of the time step. The ratio of the average neutron flux for the current time step to the average neutron flux for the previous time step (equal to 1.0 for the first time step) is then used to multiply all of the flux-dependent transformation rates in the transition matrix, thereby adjusting them to the correct flux for the current time step (2:341).

Once the neutron flux has been calculated from the power level, the system of simultaneous differential equations, represented by the coefficients in the transition matrix, is solved through a composite of three solution methods. The first solution method uses a set of asymptotic solutions to handle the buildup and decay of short-lived nuclides that do not have long-lived precursors. Most fission products fall into this category. These nuclides will approach a constant concentration (transient equilibrium) within the time step (2:341-342).

The second solution method deals with the long-lived nuclides through use of the matrix exponential method. A reduced transition matrix is formed by eliminating the short-lived members of the full transition matrix. In the case of no continuous material feed, the system is then a set of homogeneous equations which can be expressed as

$$\dot{\mathbf{X}} = \mathbf{A}\mathbf{X} \quad (3)$$

where

$\dot{\mathbf{X}}$ = time derivative of the nuclide concentrations
(a column vector)

\mathbf{A} = reduced transition matrix containing the transformation rates (a very sparse 1700 by 1700 matrix)

\mathbf{X} = nuclide concentrations (a column vector)

This equation has the solution

$$\mathbf{X}(t) = \exp(\mathbf{A}t)\mathbf{X}(0) \quad (4)$$

where

$\mathbf{X}(t)$ = concentration of each nuclide at time t

$\mathbf{X}(0)$ = vector of initial nuclide concentrations

t = time at end of time step

The matrix exponential method uses a recursion relationship to generate enough terms of the series representation of the exponential function to accurately determine $\mathbf{X}(t)$ (2:342).

The third solution method employs another set of asymptotic solutions to the differential equations and a Gauss-Seidel successive substitution algorithm to solve for the concentrations of short-lived nuclides with long-lived parents (secular equilibrium). Once this third solution method has been applied, the concentrations of all nuclides at the end of the time step have been calculated and stored. These results are then used as initial concentrations for the next time step (2:342).

Output Data

The output of the ORIGEN2 code, while potentially quite voluminous, can be controlled by the user so that only the data of interest is written to an output device. There are six basic types of output data: reactivity and burnup data, an activation product segment, an actinide segment (including daughters), a fission product segment, neutron emission rates, and photon emission rates. The reactivity and burnup data consist of less than a page of information summarizing the fluxes, burnups, specific power, and infinite multiplication factor data. The activation product, actinide, and fission product segments consist of the output of one or more of 24 different tables of information for each segment type. The neutron emission rate data is comprised of a one-page listing of the neutron production rates from (α, n) reactions for each nuclide and a one-page listing of neutron production rates from spontaneous fission for each nuclide. Photon emission rate data is broken down into an activation product segment, an actinide segment, and a fission product segment. Each segment's photon output contains summation tables and principal contributor tables. The summation tables list the photon

production rates as a function of 18 photon energy-groups. The principal contributor tables list the photon production rates for each nuclide that contributes more than a user-specified fraction of the total photon production rate for each group (1:101).

III. Modifications Made to the Code

Although the ORIGIN2 code was written to run on one of the larger IBM systems, it has also been modified to run on a Digital VAX 11/780 using the VMS operating system. Since the AFIT SSC is a VAX 11/785, it was anticipated that the changes made to run the code on the 11/780[†] would also work for the SSC. Most of the modifications did, in fact, translate satisfactorily to the SSC; however, since the SSC uses a UNIX operating system, an unforeseen problem occurred in one of the integer functions that reads the input files.

Integer function QPACK reads the input data, character by character, and constructs words from the characters. The need for such a function arises due to the free-format nature of the ORIGIN2 input files. When the SSC attempted to compile QPACK, it generated an error message relating to the use of a LOGICAL*1 variable. When LOGICAL*1 was changed to simply LOGICAL, QPACK compiled properly, but read only the first letter of each word in the ORIGIN2 command file.

After much troubleshooting, the following changes proved successful in remedying this system-related idiosyncrasy:

INTEGER FUNCTION AREAD

On line ARE 50, add AREAD to the list of integer declarations.

[†]See CCC-371 (9:v-xv) for a summary of these changes.

INTEGER FUNCTION QQPACK

Replace the entire function with the following:

```
INTEGER FUNCTION QQPACK(A,B,I)
INTEGER A,B,D,QQPACK
CHARACTER*4 E
EQUIVALENCE (D,E)
D = A
E(I:I) = CHAR(B)
QQPACK = D
RETURN
END
```

The validity of the replacement QQPACK function was verified through a three-step process. In each step, a main program supplied values of A, B, and I for use in integer function QQPACK. Values of I were constrained to integers 1 through 4, as in the ORIGEN2 code. In step one, the original QQPACK function was tested on the AFIT Classroom Support Computer (CSC), a Digital VAX with VMS operating system. Step two was to test the replacement QQPACK function on the CSC. The final step was to test the replacement QQPACK on the SSC. Table 1 shows the input values of A, B, and I that were used and the values of QQPACK that were returned in each step.

It is evident from Table 1 that the replacement QQPACK performs identically to the original QQPACK over the range of values tested. Perhaps a more convincing verification is that when the sample problem supplied with the ORIGEN2 package is run using the replacement QQPACK, the results match the sample results obtained with the original QQPACK (see Appendix I). A small anomaly in the replacement QQPACK function has been observed, however. To be properly read, the ORIGEN2 command file must have every record starting in column one. Other than this restriction, input files can still be read in a free-format.

Table 1. QPACK Verification

A	B	I	QPACK		
			Original - CSC	Replacement - CSC	Replacement - SSC
-2	-1	1	-1	-1	-1
1	-3	2	64769	64769	64769
-1	2	3	-16580609	-16580609	-16580609
0	0	1	0	0	0
2	0	2	2	2	2
0	1	1	1	1	1
8	7	4	117440520	117440520	117440520
16	18	3	1179664	1179664	1179664
31	2	3	131103	131103	131103
9	34	4	570425353	570425353	570425353

IV. Description of the ORIGEN2 Command File

The use of "commands" by ORIGEN2 provides a significant increase in flexibility compared to the original ORIGEN code with respect to simulating the situation being analyzed. An ORIGEN2 command directs the code to perform a single action, such as reading a data library or decaying the spent fuel for a specified time period. Each command is invoked by a three- or four-letter keyword with appropriate parameters for the particular operation. The series of commands is maintained in a file external to the code, thus enabling the user to make even major changes to the case under consideration with relative ease; no editing or recompilation of the code itself is necessary. The logic of this command stream is similar to a computer language such as FORTRAN. The use of ORIGEN2 commands allows one to define the flow sheet for any case to be analyzed, no matter how complex it becomes.

As an example, Figure 1 shows the command file for a case in which natural uranium fuel is irradiated for 293.3 days in a Canada deuterium uranium reactor to a burnup of 7500 megawatt-days per metric ton of initial heavy metal. The fuel composition is written to an output file every 30 days after start-up until the fuel cycle is complete. The specific commands are summarized below. For a detailed listing of all the ORIGEN2 commands and their associated parameters, refer to ORNL/TM-7175 (1:25-61a).

The first three cards (-1) are end-of-file markers. Had this case involved fuel reprocessing and the user wanted to override the default values for various fractional recovery values, then appropriate replacement data would be placed before

```

-1
-1
-1
BAS ONE METRIC TON OF CANDU FUEL
LIP C 0 0
LIB C 0 2 3 401 402 403 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
PHC C 0 0 10
DFTL E 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
DFTA E 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
DPTF E 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
INF -1 1 -1 -1 1 1
PCV -1 1 0 1.0
GLE
IAP 30 25.57 1 2 4 2
IAP 60 25.57 2 3 4 0
IAP 90 25.57 3 4 4 0
IAP 120 25.57 4 5 4 0
IAP 150 25.57 5 6 4 0
IAP 180 25.57 6 7 4 0
IAP 210 25.57 7 8 4 0
IAP 240 25.57 8 9 4 0
IAP 270 25.57 9 10 4 0
IAP 293.3 25.57 10 11 4 0
SLF
TIT * IRRADIATION OF ONE METRIC TON OF CANDU FUEL *
DIT -11 1 -1 0
EAC
2 522340 55.0 922350 7215.0 922380 952830.0 0 0.0 FUEL ACTINIDES
4 030000 1.0 050000 1.0 050000 65.4 070000 25.0 FUEL IMPUR
4 060000 124454.0 050000 10.7 110000 15.0 120000 2.0 FUEL IMPUR
4 120000 16.7 140000 12.1 150000 25.0 170000 5.3 FUEL IMPUR
4 200000 2.0 220000 1.0 230000 3.0 240000 4.0 FUEL IMPUR
4 250000 1.7 260000 18.0 270000 1.0 280000 24.0 FUEL IMPUR
4 290000 1.0 300000 40.3 420000 10.0 470000 0.1 FUEL IMPUR
4 480000 25.0 490000 2.0 500000 4.0 640000 2.5 FUEL IMPUR
4 740000 2.0 820000 1.0 820000 0.4 0 0.0 FUEL IMPUR
0

```

Figure 1. Sample ORIGEN2 Command File

each end-of-file. Even though this case performs no fuel reprocessing, the -1 end-of-file records are still required.

BAS: Case basis. Supplies an alphanumeric message to be printed in each output section.

LIP: Library print control. Specifies whether the input data libraries are to be printed.

LIB: Read decay and cross section libraries. Controls which data libraries are read and identifies the input unit for substitute data cards (if any).

PHO: Read photon libraries. Identifies which photon libraries are to be read (activation product, actinide, or fission product) and the input unit for these libraries.

OPTL: Specify activation product output options. Controls which of 24 output table types are to be printed for the activation products.

OPTA: Specify actinide output options. Controls which of 24 output table types are to be printed for the actinides.

OPTF: Specify fission product output options. Controls which of 24 output table types are to be printed for the fission products.

INP: Read input composition. Identifies where to read initial material compositions and their units. Assigns a storage vector (array) number for the initial compositions.

MOV: Move composition from vector to vector. Copies the nuclide composition data in one vector to another vector. Options include multiplying the original vector by a second vector before storing in the destination vector.

BUP: Burnup calculation. Identifies the beginning and end of a series of fuel irradiation commands.

IRP: Specific power irradiation. An irradiation step using a specified specific power. Reads the material compositions at the beginning of the interval from a specified vector and stores the compositions at the end of the interval in another specified vector.

TIT: Case title. Provides a title which is printed at the top of the page at the beginning of each output section.

OUT: Print calculated results. Controls which output vectors are to be printed and to what output unit they are directed.

END: Terminate execution. Identifies the end of the ORIGEN2 command stream.

Following the END command is the initial fuel composition, including impurities. The actinide isotopic composition and the impurities elemental composition are both expressed in grams per metric ton of initial heavy metal. Conversion from an amount of a naturally occurring impurity element to amounts of each nuclide is accomplished internally by using the natural isotopic abundances input with the decay library (1:74).

V. Cases Run

Within this section are descriptions of each of the eight cases examined. The values of the operating parameters listed below were determined by the ORIGEN2 model for each specific case. Appropriate references for these operating characteristics are also included. Each case is identified by reactor type and total burnup in gigawatt-days/metric ton of initial heavy metal (GWd/MTIHM).

The output sections of the referenced appendices contain both isotopic and elemental fuel compositions for the actinides and fission products. The zero time is at start-up with fresh fuel. Note that the compositions are expressed in fractional gram-atoms, or fraction of atoms, for each segment (actinide or fission product). For example, a value of 0.0311 for U^{235} would indicate that 3.11% of the actinides are U^{235} atoms. A cutoff fraction of 0.001 has been used, so that the only isotopes or elements listed are those which comprise at least 0.1% of their respective segment at some point during the run. This cutoff fraction pertains only to the output and has no effect on the accuracy of the calculations.

Pressurized Water Reactor (PWR), 33 GWd/MTIHM

The ORIGEN2 PWR models are based on a Westinghouse design (6:3). The operating characteristics for this case are as follows:

Total burnup: 33.0 GWd/MTIHM (6:75)

Specific power: 37.5 MW (thermal)/MTIHM (6:75)

Number of full-power days: 880 (6:75)

Fuel composition

Actinides (grams/MTIHM): 290g U²³⁴; 32,000g U²³⁵; 967,710g U²³⁸ (6:60)

Impurities (grams/MTIHM): 134,454g oxygen; traces of other elements
(6:58)

Appendix A contains the input command file for this case and the resultant output.

PWR, 50 GWd/MTIHM

The operating characteristics for this case are as follows:

Total burnup: 50.0 GWd/MTIHM (3:19)

Specific power: 37.5 MW (t)/MTIHM (3:19)

Number of full-power days: 1333 (3:19)

Fuel composition

Actinides (grams/MTIHM): 376g U²³⁴; 41,500g U²³⁵; 958,124g U²³⁸ (3:12)

Impurities (grams/MTIHM): 134,454g oxygen; traces of other elements
(6:58)

Appendix B contains the input command file for this case and the resultant output.

Boiling Water Reactor (BWR), 27.5 GWd/MTIHM

The ORIGEN2 BWR model is based on the General Electric BWR/6 design (6:3). The operating characteristics for this case are as follows:

Total burnup: 27.5 GWd/MTIHM (6:75)

Specific power: 25.9 MW (t)/MTIHM (6:75)

Number of full-power days: 1062 (6:75)

Fuel composition

Actinides (grams/MTIHM): 247g U²³⁴; 27,500g U²³⁵; 972,253g U²³⁸ (6:60)

Impurities (grams/MTIHM): 134,454g oxygen; traces of other elements
(6:58)

Appendix C contains the input command file for this case and the resultant output.

Canada Deuterium Uranium Reactor (CANDU), 7.5 GWd/MTIHM

The ORIGEN2 CANDU models are based on the Gentilly 2 reactor, which is typical of modern CANDU reactors (4:2). This case uses natural uranium as its fuel. Its operating characteristics are as follows:

Total burnup: 7.5 GWd/MTIHM (4:33)

Specific power: 25.57 MW (t)/MTIHM (4:33)

Number of full-power days: 293.3 (4:33)

Fuel composition

Actinides (grams/MTIHM): 55g U²³⁴; 7115g U²³⁵; 992,830g U²³⁸ (4:29)

Impurities (grams/MTIHM): 134,454g oxygen; traces of other elements
(4:28)

Appendix D contains the input command file for this case and the resultant output.

CANDU, 20.9 GWd/MTIHM

This case uses slightly enriched uranium as its fuel. Its operating characteristics are as follows:

Total burnup: 20.9 GWd/MTIHM (4:33)

Specific power: 25.57 MW (t)/MTIHM (4:33)

Number of full-power days: 817.4 (4:33)

Fuel composition

Actinides (grams/MTIHM): 102g U²³⁴; 12,000g U²³⁵; 987,898g U²³⁸ (4:29)

Impurities (grams/MTIHM): 134,454g oxygen; traces of other elements
(4:28)

Appendix E contains the input command file for this case and the resultant output.

Liquid-Metal Fast Breeder Reactor (LMFBR) - Core, 100 GWd/MTIHM

The ORIGEN2 LMFBR models are patterned after a commercial design based on the Prototype Large Breeder Reactor study (5:2). The operating characteristics for this case are as follows:

Total burnup: 101 GWd/MTIHM (5:20)

Specific power: 123.25 MW (t)/MTIHM (5:20)

Number of full-power days: 822 (5:20)

Fuel composition

Actinides (grams/MTIHM): 1676g U²³⁵; 813,656g U²³⁸; 2586g Pu²³⁸;
101,567g Pu²³⁹; 46,738g Pu²⁴⁰; 24,557g Pu²⁴¹;
9220g Pu²⁴² (5:18)

Impurities (grams/MTIHM): 134,454g oxygen; traces of other elements
(5:19)

Appendix F contains the input command file for this case and the resultant output.

LMFBR - Axial Blanket, 100 GWd/MTIHM

The operating characteristics for this case are as follows:

Total burnup: 5.66 GWd/MTIHM (5:20)

Specific power: 6.89 MW (t)/MTIHM (5:20)

Number of full-power days: 822 (5:20)

Fuel composition

Actinides (grams/MTIHM): 2000g U²³⁵; 998,000g U²³⁸ (5:16)

Impurities (grams/MTIHM): 134,454g oxygen; traces of other elements
(5:19)

Appendix G contains the input command file for this case and the resultant output.

LMFBR - Radial Blanket, 100 GWd/MTIHM

The operating characteristics for this case are as follows:

Total burnup: 5.9 GWd/MTIHM (5:20)

Specific power: 3.59 MW (t)/MTIHM (5:20)

Number of full-power days: 1644 (5:20)

Fuel composition

Actinides (grams/MTIHM): 2000g U^{235} ; 998,000g U^{238} (5:16)

Impurities (grams/MTIHM): 134,454g oxygen; traces of other elements
(5:19)

Appendix H contains the input command file for this case and the resultant output.

VI. Results

The volume of data pertaining to the isotopic fuel compositions appearing in Appendices A through H leads to some difficulty in making direct comparisons among the various cases. This section presents plots derived from this data to facilitate such comparisons. The latter portion of this section shows how to convert fractional gram-atoms to grams.

Illustrative Plots

In order to allow meaningful comparisons among the cases studied and to draw conclusions regarding the distinctiveness of each case, a number of visual representations of the output data are presented on the following pages. Consistent with the output format of ORIGEN2, the plots depict fission products and actinides separately. Figures 2 and 3 show the amounts of selected fission product isotopes relative to the amount of Mo^{99} at 270 days and 720 days, respectively. Mo^{99} was used as the fission product ratio basis so as to maintain compatibility with current AFTAC analysis techniques. To keep the plots from becoming too "cluttered," only one example of each reactor type is shown: PWR (3.2% U^{235}), BWR (2.75% U^{235}), CANDU (1.2% U^{235}), and LMFBR (core).

Figures 4 through 7 depict actinide compositions relative to U^{238} . Since the fissile fuel of the LMFBR is PuO_2 , there is a large LMFBR Pu^{239} content reflected in Figures 4 and 6. To better illustrate the actinide compositions of the other three reactor types, Figures 5 and 7 have omitted the LMFBR case.

Fission Products - 270 Days

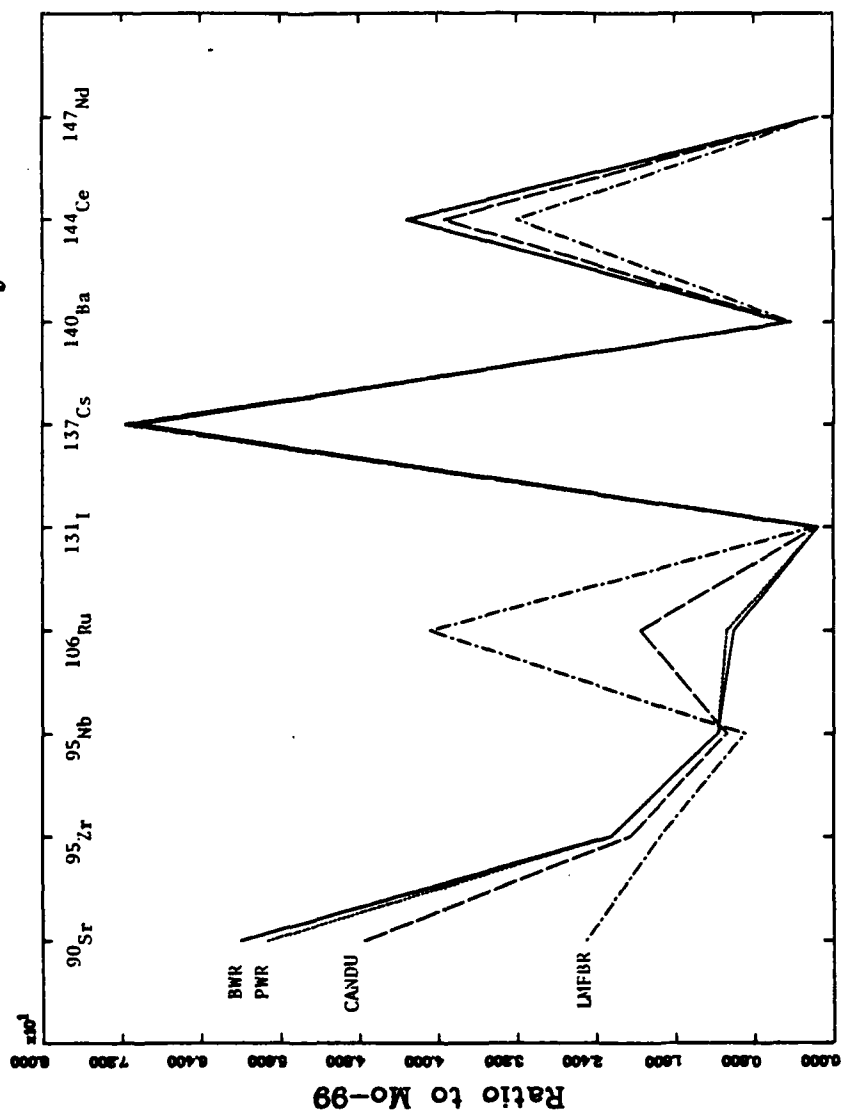


Figure 2. Fission Product Compositions - 270 Days

Fission Products - 720 Days

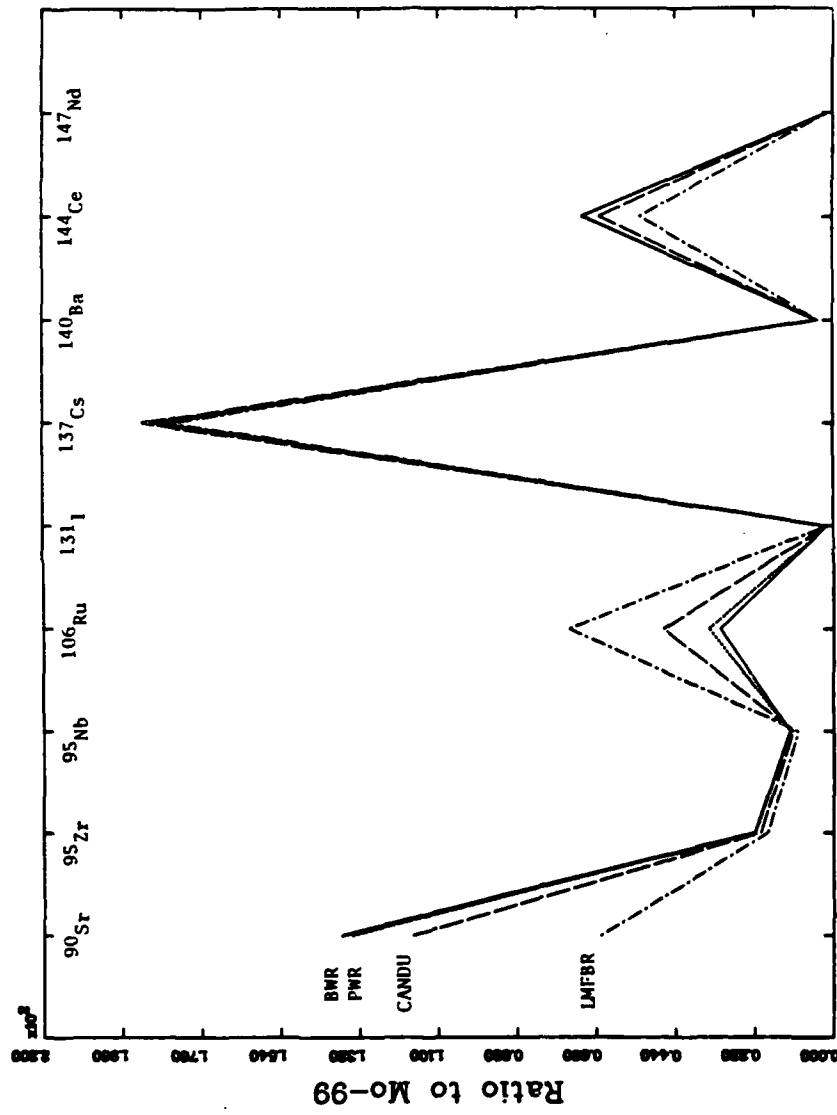


Figure 3. Fission Product Compositions - 720 Days

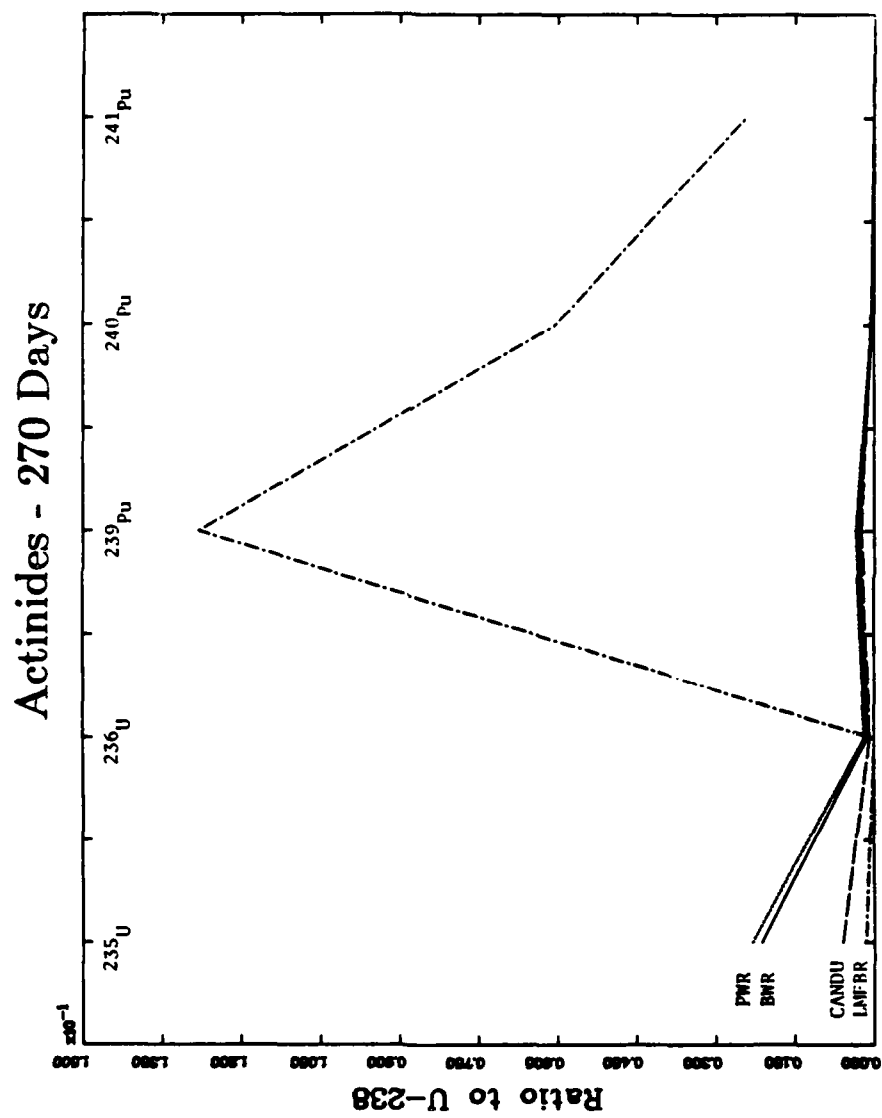


Figure 4. Actinide Compositions - 270 Days

Actinides (w/o LMFB) - 270 Days

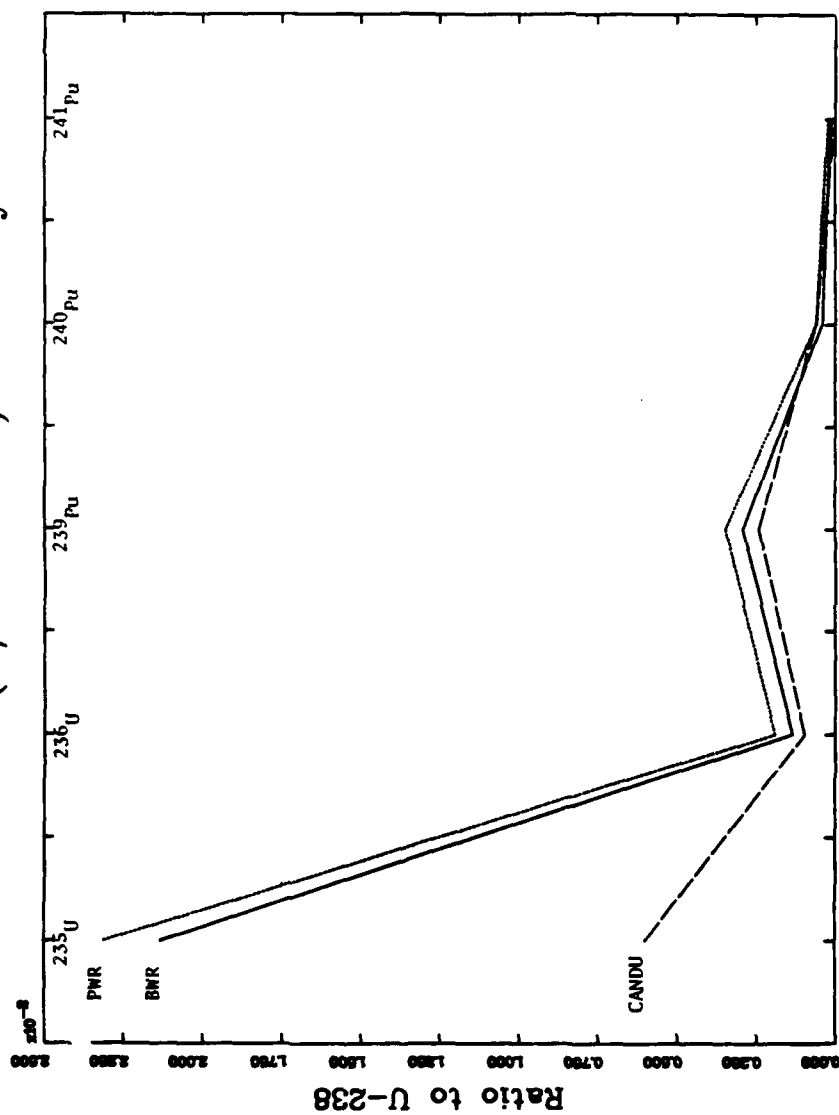


Figure 5. Actinide Compositions (without LMFB case) - 270 Days

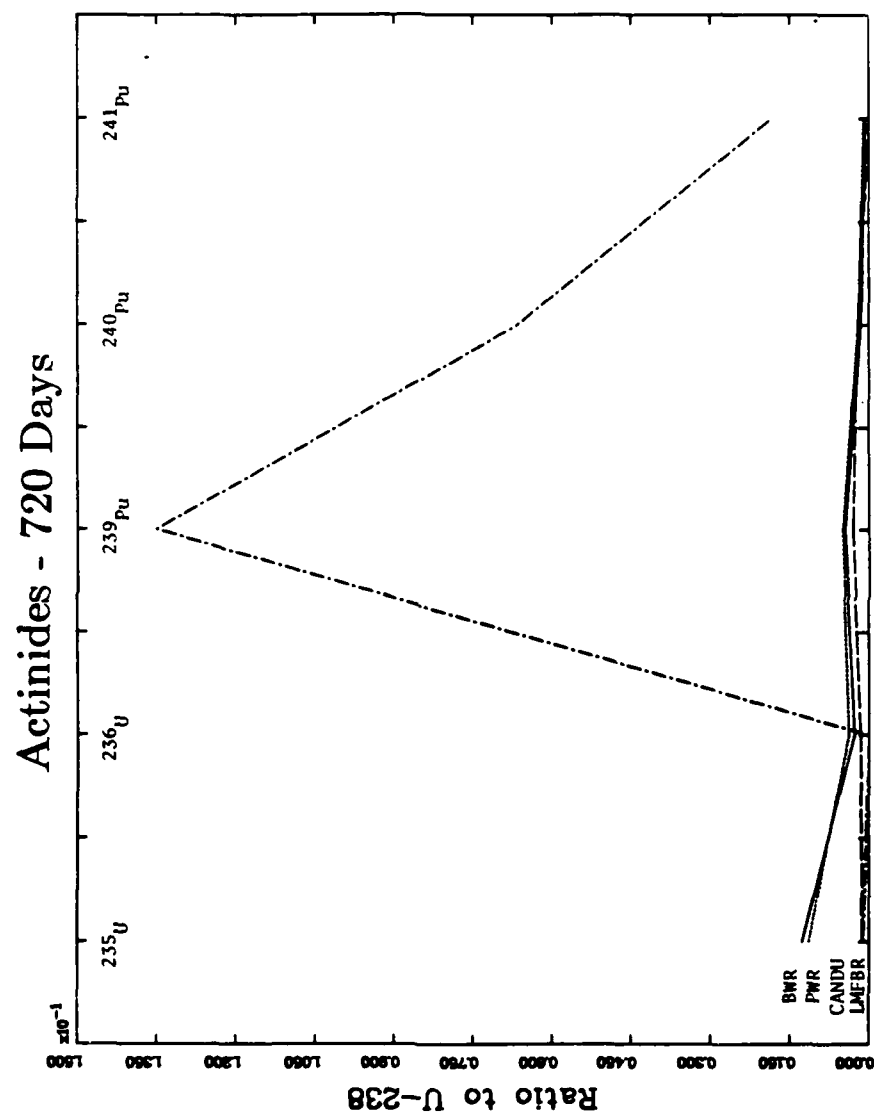


Figure 6. Actinide Compositions - 720 Days

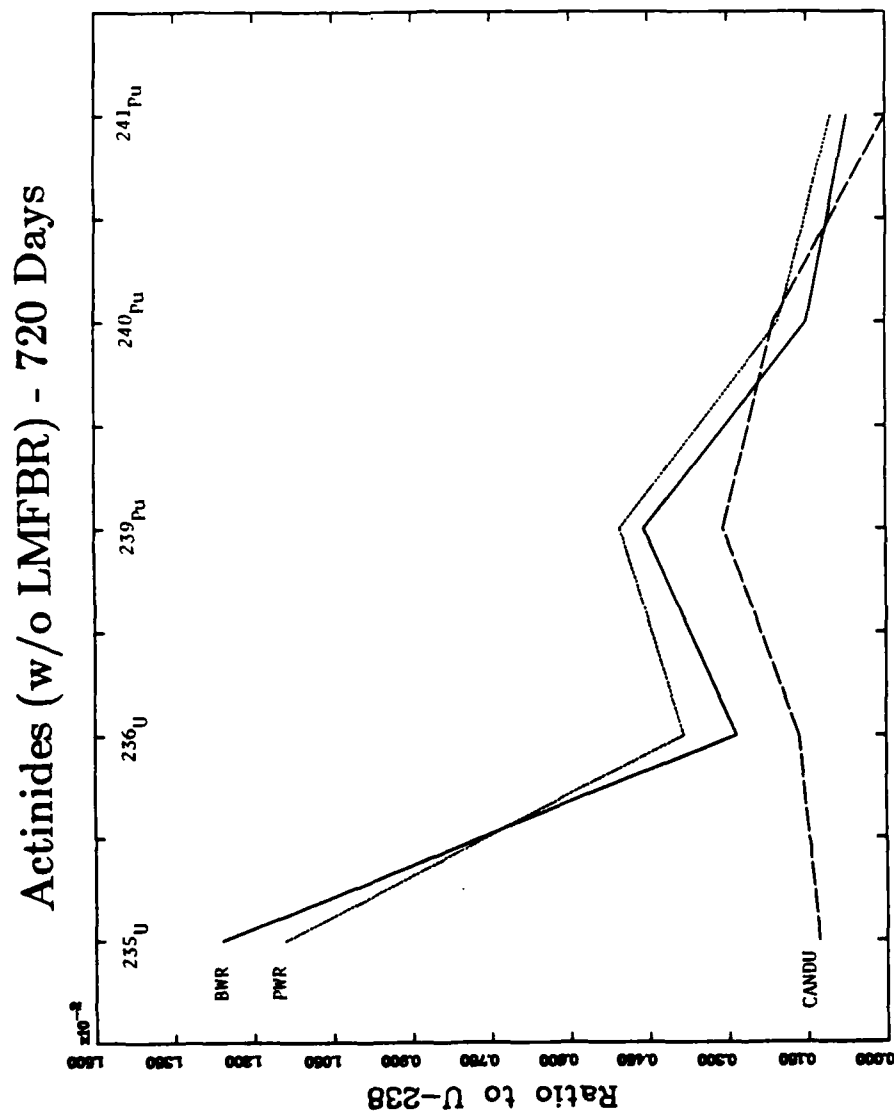


Figure 7. Actinide Compositions (without LMFBR case) - 720 Days

Conversion of Fractional Gram-atoms to Grams

For many applications, isotopic fuel composition expressed in grams is more useful than composition in fractional gram-atoms. Without re-running the ORIGEN2 code, some approximations can be made which will allow the output data in the appendices to be converted from fractional gram-atoms to grams with fairly good results (within three or four percent).

To calculate the amount of a given fission product in grams, assume that each fission releases 200 MeV of energy and produces 2 fission fragments. The following equation may then be used:

$$\begin{aligned} \frac{\text{grams}}{\text{MTIHM}} = & \left(\text{Burnup in } \frac{\text{MWd}}{\text{MTIHM}} \right) \left(2.70 \times 10^{21} \frac{\text{fissions}}{\text{MWd}} \right) \left(2 \frac{\text{fission products}}{\text{fission}} \right) \\ & \times \left(\text{Fraction of atoms} \right) \left(\frac{\text{Gram atomic wt.}}{\text{mole}} \right) \\ & \div \left(6.022 \times 10^{23} \frac{\text{fission fragments}}{\text{mole}} \right) \end{aligned} \quad (5)$$

As an example, consider the Cs^{137} production in a 33 GWd/MTIHM PWR at 880 days. From Appendix A, the fractional number of Cs^{137} atoms is found to be 3.026×10^{-2} . Using Eq (5), the equivalent number of grams/MTIHM is determined thus:

$$\begin{aligned} \frac{\text{grams}}{\text{MTIHM}} = & \left(33,000 \frac{\text{MWd}}{\text{MTIHM}} \right) \left(2.70 \times 10^{21} \frac{\text{fissions}}{\text{MWd}} \right) \left(2 \frac{\text{fission products}}{\text{fission}} \right) \\ & \times (3.026 \times 10^{-2}) \left(137 \frac{\text{grams}}{\text{mole}} \right) \\ & \div \left(6.022 \times 10^{23} \frac{\text{fission fragments}}{\text{mole}} \right) \\ = & 1227 \text{ grams} \end{aligned}$$

This approximation is within 2.43% of the ORIGEN2-generated value of 1198 grams.

The assumption of 200 MeV per fission is also implicit in converting fractional gram atoms of actinides to grams, as shown below:

$$\begin{aligned} \frac{\text{grams}}{\text{MTIHM}} &= \left[\left(\text{Moles of fuel initially} \right) - \left(\text{Moles of fuel burned} \right) \right] \left(\text{Gram at. wt.} \right) \left(\text{Fraction of atoms} \right) \\ &= \left[\left(\frac{10^6 \text{ grams/MTIHM}}{\text{Average atomic weight}} \right) - \left(\frac{(\text{Burnup in MWd/MTIHM})(2.70 \times 10^{21} \text{ fissions/MWd})}{6.022 \times 10^{23} \text{ fissions/mole}} \right) \right] \\ &\quad \times (\text{Gram atomic wt.})(\text{Fraction of atoms}) \end{aligned} \quad (6)$$

As an example, consider the U^{235} depletion in the same 33 GWd/MTIHM PWR at 880 days. From Appendix A, the fractional number of U^{235} atoms is found to be 8.348×10^{-3} . Eq (6) can then be used to compute the equivalent number of grams/MTIHM:

$$\begin{aligned} \frac{\text{grams}}{\text{MTIHM}} &= \left[\left(\frac{10^6 \text{ grams/MTIHM}}{237.9} \right) - \left(\frac{(33,000 \text{ MWd/MTIHM})(2.70 \times 10^{21} \text{ fissions/MWd})}{6.022 \times 10^{23} \text{ fissions/mole}} \right) \right] \\ &\quad \times (235)(8.348 \times 10^{-3}) \\ &= 7956 \text{ grams} \end{aligned}$$

This value compares quite favorably (within 0.09%) to the ORIGEN2-generated value of 7963 grams.

VII. Conclusion

The primary objectives of this thesis, as set forth in Section I, have been met. The ORIGEN2 code was adapted and modified to run on the AFIT SSC system. The details of the modifications required to run the code on a UNIX-based VAX system were described in Section III and have been forwarded to Mr. Scott Ludwig, Oak Ridge National Laboratory, for inclusion in the next update to CCC-371. Appendix J is directed toward future ORIGEN2 users at AFIT and includes helpful suggestions for running the code on the SSC in particular, though, in general, much of this appendix can be applied to any computer with a UNIX operating system. The cases selected for analysis were meant to be representative of typical commercial nuclear reactors. The results of these analyses have been included in a comparatively lengthy set of appendices so that the individual with an interest in any of these specific cases will not have to duplicate the efforts that were required to produce each group of output data. As seen from Section VI, the isotopic compositions of both the actinide and fission product segments are distinctive enough to distinguish among the different reactor types examined in this study.

It is worth re-emphasizing that the fuel compositions presented in Appendices A through H, except for initial compositions contained in the command files, are expressed in fraction of atoms relative to each segment--actinide or fission product. The ORIGEN2 code does not easily generate output based on anything but the respective segment.

An area for further study might be to modify the code or otherwise devise a method to output results with respect to the entire fuel composition. Another area of follow-on study would be the determination of fuel composition after a

sample has been removed from the reactor and allowed to decay for a given period of time. A third, more ambitious topic is that of creating a cross section library for a reactor type not already within the ORIGEN2 files, such as the Chernobyl RBMK reactor. Finally, future ORIGEN2 use would be greatly facilitated by the construction of a separate code, based on interactive inputs provided by the user, to build the ORIGEN2 command file. Such a code is envisioned to be user-friendly, combining menus, help features, appropriate default values, etc., so that someone familiar with nuclear reactors, but not the mechanics of the command file, could use the ORIGEN2 code with much less difficulty than is presently the case.

Command File and Output Data

```

-1
-1
-1
BAS ONE METRIC TON OF PWR-U FUEL
LIP 0 0 0
LIB 0 0 2 3 204 205 206 5 3 0 1 1
PHO 0 0 0 10
DPTL 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8
OPTA 8 8 8 7 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8
OPTF 8 8 8 7 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8
INP -1 1 -1 -1 1 1
MOV -1 1 0 1.0
BUP
IRP 30 37.5 1 2 4 2
IRP 60 37.5 2 3 4 0
IRP 90 37.5 3 4 4 0
IRP 180 37.5 4 5 4 0
IRP 270 37.5 5 6 4 0
IRP 360 37.5 6 7 4 0
IRP 450 37.5 7 8 4 0
IRP 540 37.5 8 9 4 0
IRP 630 37.5 9 10 4 0
IRP 720 37.5 10 11 4 0
IRP 880 37.5 11 12 4 0
BUP
TIT * IRRADIATION OF ONE METRIC TON OF PWR-U FUEL *
OUT 12 1 -1 0
END
2 922340 290.0 922350 32000.0 922380 967710.0 0 0.0 FUEL ACTINIDES
4 030000 1.0 050000 1.0 060000 89.4 070000 25.0 FUEL IMPUR
4 080000 134454.0 090000 10.7 110000 15.0 120000 2.0 FUEL IMPUR
4 130000 16.7 140000 12.1 150000 35.0 170000 5.3 FUEL IMPUR
4 200000 2.0 220000 1.0 230000 3.0 240000 4.0 FUEL IMPUR
4 250000 1.7 260000 18.0 270000 1.0 280000 24.0 FUEL IMPUR
4 290000 1.0 300000 40.3 420000 10.0 470000 0.1 FUEL IMPUR
4 480000 25.0 490000 2.0 500000 4.0 640000 2.5 FUEL IMPUR
4 740000 2.0 820000 1.0 830000 0.4 0 0.0 FUEL IMPUR
0

```


* IRRADIATION OF ONE METRIC TON OF PWR-U FUEL *
 POWER= 3.75000e+01 MW, BURNUP= 3.30000e+04 MWD, FLUX= 3.24e+14 N/CM^2-SEC
 REACTIVITY AND BURNUP DATA
 BASIS= METRIC TON OF PWR-U FUEL

	0. S	30.00	60.00	90.00	180.00	270.00	360.00	450.00	540.00	630.00	720.00	880.00
TIME, SEC	0.00e+00	2.59e+06	5.18e+06	7.78e+06	1.56e+07	2.33e+07	3.11e+07	3.89e+07	4.67e+07	5.46e+07	6.22e+07	7.60e+07
NEUT. FLUX	0.00e+00	2.89e+14	2.89e+14	2.89e+14	2.91e+14	2.97e+14	3.03e+14	3.13e+14	3.27e+14	3.39e+14	3.48e+14	3.71e+14
SP PCW/MW	0.00e+00	3.75e+01	3.75e+01	3.75e+01	2.75e+01	3.75e+01	3.75e+01	3.75e+01	3.75e+01	3.75e+01	3.75e+01	3.75e+01
BURNUP/MWD	0.00e+00	1.13e+03	1.13e+03	1.13e+03	1.38e+03	3.38e+03	3.38e+03	3.38e+03	3.38e+03	3.38e+03	3.38e+03	6.00e+03
K INFINITY	0.	1.35e17	1.34066	1.32824	1.27755	1.22889	1.18379	1.15026	1.11409	1.07688	1.03906	0.98675
NEUT PRODN	0.00e+00	1.00e+04	1.01e+04	1.01e+04	1.00e+04	9.84e+03	9.58e+03	9.28e+03	8.99e+03	8.70e+03	8.37e+03	7.89e+03
NEUT DESTN	0.00e+00	7.39e+03	7.51e+03	7.60e+03	7.84e+03	8.00e+03	8.10e+03	8.07e+03	8.07e+03	8.08e+03	8.05e+03	8.00e+03
TOT BURNUP	0.00e+00	3.30e+04	3.30e+04	3.30e+04	3.30e+04	3.30e+04	3.30e+04	3.30e+04	3.30e+04	3.30e+04	3.30e+04	3.30e+04
AVG N FLUX	0.00e+00	3.24e+14	3.24e+14	3.24e+14	3.24e+14	3.24e+14	3.24e+14	3.24e+14	3.24e+14	3.24e+14	3.24e+14	3.24e+14
AVG SP PCW	0.00e+00	3.75e+01	3.75e+01	3.75e+01	3.75e+01	3.75e+01	3.75e+01	3.75e+01	3.75e+01	3.75e+01	3.75e+01	3.75e+01

SIZE OF MMAX(I): MMAX= 1 8= 568 MMAX= 2 8= 252 MMAX= 3 8= 72 MMAX= 4 8= 26 MMAX= 5 8= 31 MMAX= 6 8= 29
 MMAX= 7 8= 24 MMAX= 8 8= 0 MMAX= 9 8= 0 MMAX= 10 8= 0 MMAX= 11 8= 0 MMAX= 12 8= 0

THE NUMBER OF MCN-ZERO TERMS IN A=4913
 THE NUMBER OF NON-ZERO FISSION PRODUCT YIELDS=3242
 ILITE= 0 IACT= 125 IPP= 879 ITOT=1008
 THE NUMBER OF MCN-ZERO NATURAL ABUNDANCES= 154
 THE NUMBER OF MCN-ZERO PHCTON YIELDS= 0
 THE MAXIMUM NUMBER CP TERPS IN AP= 2179

OUTPUT UNIT = 11

* IRRADIATION OF ONE METRIC TON OF PHR-U FUEL *

POWER= 3.75000e+01 MW, BURNUP= 3.30000e+04 MWD, FLUX= 3.24e+14 N/CM^2-SEC
 & SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS
 METRIC TON OF PHR-U FUEL

ACTINIDES+CAUGHTERS

	0. S	30.00	60.00	90.00	180.00	270.00	360.00	450.00	540.00	630.00	720.00	880.00
U235	3.240e-02	3.110e-02	2.987e-02	2.868e-02	2.535e-02	2.242e-02	1.973e-02	1.725e-02	1.501e-02	1.298e-02	1.114e-02	8.348e-03
U236	0.000e+00	2.435e-04	4.762e-04	6.982e-04	1.309e-03	1.848e-03	2.327e-03	2.755e-03	3.131e-03	3.457e-03	3.741e-03	4.134e-03
U238	9.673e-01	9.677e-01	9.682e-01	9.686e-01	9.699e-01	9.711e-01	9.723e-01	9.734e-01	9.744e-01	9.753e-01	9.761e-01	9.773e-01
PU239	0.000e+00	5.324e-04	1.083e-03	1.530e-03	2.616e-03	3.360e-03	3.883e-03	4.281e-03	4.566e-03	4.763e-03	4.911e-03	5.092e-03
PU240	0.000e+00	1.242e-05	5.121e-05	1.068e-04	3.356e-04	8.749e-04	1.177e-03	1.451e-03	1.699e-03	1.899e-03	1.976e-03	2.271e-03
PU241	0.000e+00	6.285e-07	4.623e-06	1.432e-05	8.755e-05	2.264e-04	3.903e-04	5.337e-04	7.091e-04	8.892e-04	1.005e-03	1.250e-03
SUMTOT	9.997e-01	9.996e-01	9.996e-01	9.996e-01	9.996e-01	9.996e-01	9.995e-01	9.994e-01	9.992e-01	9.991e-01	9.989e-01	9.985e-01
TOTAL	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00

OUTPUT UNIT = 11

* IRRADIATION OF ONE METRIC TON OF PHR-U FUEL *

POWER= 3.75000e+01 MW, BURNUP= 3.30000e+04 MWD, FLUX= 3.24e+14 N/CM^2-SEC
 & SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS
 METRIC TON OF PHR-U FUEL

ACTINIDES+CAUGHTERS

	0. S	30.00	60.00	90.00	180.00	270.00	360.00	450.00	540.00	630.00	720.00	880.00
U	1.000e+00	9.994e-01	9.988e-01	9.983e-01	9.968e-01	9.956e-01	9.946e-01	9.936e-01	9.928e-01	9.920e-01	9.912e-01	9.900e-01
PU	0.000e+00	5.467e-04	1.115e-03	1.652e-03	2.046e-03	4.209e-03	5.208e-03	6.099e-03	6.901e-03	7.615e-03	8.260e-03	9.306e-03
SUMTOT	1.000e+00	9.999e-01	9.999e-01	9.999e-01	9.999e-01	9.998e-01	9.998e-01	9.997e-01	9.997e-01	9.996e-01	9.995e-01	9.993e-01
TOTAL	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00

FISSION PRODUCTS

* IRRADIATION OF ONE METRIC TON OF PWR-U FUEL *

POWER= 3.75000E+01 MW, BURNUP= 3.30000E+04 MW, FLUX= 3.24E+14 N/CM^2-SEC

4 SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS

METRIC TON OF PWR-U FUEL

	0. S	30.00	60.00	90.00	180.00	270.00	360.00	450.00	540.00	630.00	720.00	880.00
BR 01	0.000E+00	1.644E-03	1.058E-03	1.032E-03	1.036E-03	1.021E-03	1.007E-03	9.927E-04	9.787E-04	9.645E-04	9.506E-04	9.257E-04
SE 02	0.000E+00	1.452E-03	1.637E-03	1.645E-03	1.593E-03	1.593E-03	1.539E-03	1.517E-03	1.510E-03	1.476E-03	1.454E-03	1.419E-03
KR 03	0.000E+00	2.415E-03	2.580E-03	2.541E-03	2.429E-03	2.320E-03	2.224E-03	2.130E-03	2.037E-03	1.946E-03	1.859E-03	1.707E-03
KR 04	0.000E+00	5.646E-03	5.028E-03	4.997E-03	4.924E-03	4.866E-03	4.821E-03	4.785E-03	4.755E-03	4.727E-03	4.703E-03	4.667E-03
KR 05	0.000E+00	1.394E-03	1.283E-03	1.280E-03	1.225E-03	1.186E-03	1.150E-03	1.118E-03	1.087E-03	1.057E-03	1.029E-03	9.806E-04
RB 06	0.000E+00	4.811E-03	4.776E-03	4.776E-03	4.612E-03	4.503E-03	4.407E-03	4.322E-03	4.240E-03	4.161E-03	4.087E-03	3.940E-03
KR 07	0.000E+00	9.709E-03	5.577E-03	9.459E-03	9.160E-03	8.900E-03	8.674E-03	8.472E-03	8.281E-03	8.098E-03	7.927E-03	7.636E-03
SR 08	0.000E+00	1.355E-02	1.224E-02	1.207E-02	1.168E-02	1.135E-02	1.105E-02	1.079E-02	1.053E-02	1.029E-02	1.007E-02	9.688E-03
SR 09	0.000E+00	1.833E-02	1.736E-02	1.716E-02	1.661E-02	1.613E-02	1.570E-02	1.532E-02	1.496E-02	1.462E-02	1.429E-02	1.374E-02
Y 09	0.000E+00	4.163E-03	1.777E-03	1.675E-03	1.786E-03	1.786E-03	1.781E-03	1.781E-03	1.781E-03	1.781E-03	1.781E-03	1.781E-03
SR 90	0.000E+00	2.741E-02	2.700E-02	2.663E-02	2.566E-02	2.482E-02	2.407E-02	2.340E-02	2.276E-02	2.215E-02	2.158E-02	2.060E-02
Y 91	0.000E+00	2.328E-02	1.970E-02	1.872E-02	1.876E-02	1.876E-02	1.876E-02	1.876E-02	1.876E-02	1.876E-02	1.876E-02	1.876E-02
ZR 91	0.000E+00	4.599E-03	1.899E-03	1.864E-03	1.864E-03	1.864E-03	1.864E-03	1.864E-03	1.864E-03	1.864E-03	1.864E-03	1.864E-03
ZR 92	0.000E+00	2.874E-02	2.869E-02	2.838E-02	2.772E-02	2.711E-02	2.657E-02	2.608E-02	2.562E-02	2.517E-02	2.475E-02	2.404E-02
ZR 93	0.000E+00	3.686E-02	3.089E-02	3.074E-02	3.020E-02	2.966E-02	2.916E-02	2.870E-02	2.826E-02	2.783E-02	2.742E-02	2.671E-02
ZR 94	0.000E+00	3.636E-02	3.011E-02	2.994E-02	2.952E-02	2.915E-02	2.882E-02	2.852E-02	2.824E-02	2.796E-02	2.770E-02	2.727E-02
ZR 95	0.000E+00	2.688E-02	2.301E-02	1.987E-02	1.944E-02	1.900E-02	1.856E-02	1.812E-02	1.768E-02	1.724E-02	1.680E-02	1.618E-02
MB 95	0.000E+00	3.796E-03	5.694E-03	6.502E-03	6.242E-03	5.944E-03	5.604E-03	5.276E-03	4.960E-03	4.656E-03	4.363E-03	3.983E-03
PC 95	0.000E+00	8.655E-04	2.600E-03	4.776E-03	1.106E-02	1.559E-02	1.852E-02	2.040E-02	2.160E-02	2.236E-02	2.285E-02	2.276E-02
ZR 96	0.000E+00	3.697E-02	3.083E-02	3.071E-02	3.043E-02	3.017E-02	2.994E-02	2.973E-02	2.952E-02	2.932E-02	2.913E-02	2.880E-02
MC 96	0.000E+00	4.488E-06	1.065E-05	2.176E-05	6.333E-05	1.780E-04	2.938E-04	4.247E-04	5.688E-04	7.220E-04	8.802E-04	1.183E-03
PO 97	0.000E+00	2.813E-02	2.859E-02	2.872E-02	2.880E-02	2.876E-02	2.866E-02	2.853E-02	2.840E-02	2.828E-02	2.816E-02	2.804E-02
PO 98	0.000E+00	2.509E-02	2.908E-02	2.907E-02	2.913E-02	2.912E-02	2.913E-02	2.913E-02	2.913E-02	2.913E-02	2.913E-02	2.913E-02
PO 99	0.000E+00	3.552E-03	1.977E-03	1.315E-03	6.526E-04	4.328E-04	3.234E-04	2.500E-04	2.151E-04	1.843E-04	1.609E-04	1.300E-04
TC 99	0.000E+00	2.559E-02	2.743E-02	2.823E-02	2.876E-02	2.907E-02	2.937E-02	2.967E-02	2.997E-02	3.027E-02	3.057E-02	3.087E-02
PO100	0.000E+00	3.134E-02	1.359E-02	3.144E-02	3.146E-02	3.173E-02	3.183E-02	3.191E-02	3.198E-02	3.203E-02	3.208E-02	3.216E-02
RU100	0.000E+00	8.772E-05	1.892E-04	2.909E-04	5.970E-04	9.083E-04	1.225E-03	1.551E-03	1.895E-03	2.249E-03	2.608E-03	3.286E-03
RU101	0.000E+00	2.573E-02	2.579E-02	2.585E-02	2.602E-02	2.614E-02	2.623E-02	2.630E-02	2.635E-02	2.639E-02	2.641E-02	2.643E-02
RU102	0.000E+00	2.196E-02	2.217E-02	2.237E-02	2.259E-02	2.282E-02	2.306E-02	2.330E-02	2.354E-02	2.378E-02	2.402E-02	2.426E-02
RU103	0.000E+00	1.305E-02	1.066E-02	8.904E-03	5.797E-03	4.274E-03	3.402E-03	2.844E-03	2.470E-03	2.198E-03	1.982E-03	1.693E-03
RU104	0.000E+00	1.679E-02	1.124E-02	1.161E-02	1.263E-02	1.344E-02	1.424E-02	1.496E-02	1.560E-02	1.616E-02	1.663E-02	1.702E-02
PO105	0.000E+00	3.781E-05	1.349E-04	2.740E-04	6.416E-04	1.533E-03	2.284E-03	3.079E-03	3.916E-03	4.776E-03	5.638E-03	7.231E-03
PO106	0.000E+00	5.548E-03	6.157E-03	6.600E-03	7.653E-03	8.513E-03	9.240E-03	9.870E-03	1.045E-02	1.100E-02	1.150E-02	1.211E-02
PO106	0.000E+00	3.649E-03	3.353E-03	3.617E-03	4.237E-03	4.979E-03	5.895E-03	6.930E-03	8.095E-03	9.397E-03	1.080E-03	1.231E-02
PO106	0.000E+00	5.163E-04	6.902E-04	8.425E-04	1.333E-03	1.871E-03	2.442E-03	3.037E-03	3.655E-03	4.320E-03	5.072E-03	5.868E-03
PO107	0.000E+00	1.647E-03	1.977E-03	2.263E-03	2.625E-03	3.092E-03	3.672E-03	4.367E-03	5.185E-03	6.050E-03	6.978E-03	7.968E-03
PC108	0.000E+00	9.458E-04	1.165E-03	1.368E-03	1.911E-03	2.388E-03	2.813E-03	3.196E-03	3.563E-03	3.917E-03	4.249E-03	4.808E-03
AG109	0.000E+00	5.622E-04	7.038E-04	8.944E-04	1.149E-03	1.411E-03	1.628E-03	1.808E-03	1.968E-03	2.110E-03	2.234E-03	2.419E-03
PO110	0.000E+00	3.592E-04	4.601E-04	5.170E-04	6.703E-04	8.076E-04	9.320E-04	1.046E-03	1.157E-03	1.266E-03	1.365E-03	1.547E-03
CO110	0.000E+00	7.557E-06	1.796E-05	3.090E-05	8.300E-05	1.530E-04	2.385E-04	3.372E-04	4.558E-04	5.870E-04	7.302E-04	1.023E-03
TE127	0.000E+00	2.206E-03	2.353E-03	2.395E-03	2.507E-03	2.597E-03	2.672E-03	2.736E-03	2.794E-03	2.848E-03	2.897E-03	2.946E-03
TE129	0.000E+00	3.476E-03	3.651E-03	3.784E-03	3.858E-03	3.919E-03	3.968E-03	4.006E-03	4.034E-03	4.052E-03	4.060E-03	4.060E-03
TE130	0.000E+00	7.563E-03	8.058E-03	8.147E-03	8.386E-03	8.596E-03	8.749E-03	8.866E-03	8.947E-03	9.017E-03	9.073E-03	9.119E-03
TE131	0.000E+00	5.228E-03	2.848E-03	1.925E-03	1.865E-04	6.588E-04	5.037E-04	4.051E-04	3.421E-04	2.959E-04	2.601E-04	2.130E-04
TE132	0.000E+00	9.222E-03	1.143E-02	1.251E-02	1.328E-02	1.372E-02	1.406E-02	1.430E-02	1.446E-02	1.456E-02	1.462E-02	1.464E-02
TE132	0.000E+00	3.295E-03	1.713E-03	1.147E-03	5.793E-04	3.886E-04	2.929E-04	2.353E-04	1.976E-04	1.704E-04	1.487E-04	1.217E-04
TE132	0.000E+00	1.247E-02	2.043E-02	2.126E-02	2.261E-02	2.351E-02	2.428E-02	2.490E-02	2.546E-02	2.596E-02	2.640E-02	2.678E-02
TE133	0.000E+00	1.198E-03	6.993E-04	4.651E-04	2.311E-04	1.332E-04	1.146E-04	9.154E-05	7.600E-05	6.508E-05	5.675E-05	4.578E-05
TE133	0.000E+00	7.501E-03	4.047E-03	2.696E-03	1.395E-03	9.355E-04	6.915E-04	5.515E-04	4.595E-04	3.566E-04	2.771E-04	2.771E-04

OUTPUT UNIT = 11

FISSION PRODUCTS

* IRRADIATION OF ONE METRIC TON OF PWR-U FUEL *

POWER= 3.75000e+01 MW, BURNUP= 3.30000e+04 MWD, FLUX= 3.24e+14 N/CM^2-SEC

4 SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS

METRIC TON OF PWR-U FUEL

	0. S	30.00	60.00	90.00	180.00	270.00	360.00	450.00	540.00	630.00	720.00	800.00
CS133	0.000e+00	2.395e-02	2.861e-02	3.015e-02	3.127e-02	3.141e-02	3.126e-02	3.099e-02	3.064e-02	3.025e-02	2.982e-02	2.939e-02
HE134	0.000e+00	3.607e-02	2.810e-02	3.809e-02	3.807e-02	3.807e-02	3.801e-02	3.799e-02	3.797e-02	3.796e-02	3.796e-02	3.792e-02
CS134	0.000e+00	6.644e-03	2.191e-04	3.548e-04	7.611e-04	1.128e-03	1.467e-03	1.787e-03	2.050e-03	2.387e-03	2.655e-03	3.108e-03
CS135	0.000e+00	7.404e-03	7.481e-03	7.513e-03	7.568e-03	7.589e-03	7.603e-03	7.607e-03	7.603e-03	7.605e-03	7.623e-03	7.670e-03
HE136	0.000e+00	5.471e-02	5.695e-02	5.711e-02	5.750e-02	5.782e-02	5.809e-02	5.835e-02	5.862e-02	5.888e-02	5.913e-02	5.939e-02
CS137	0.000e+00	3.635e-02	3.035e-02	3.036e-02	3.040e-02	3.042e-02	3.042e-02	3.040e-02	3.038e-02	3.036e-02	3.033e-02	3.026e-02
PA138	0.000e+00	3.341e-02	3.331e-02	3.322e-02	3.301e-02	3.282e-02	3.266e-02	3.251e-02	3.238e-02	3.226e-02	3.214e-02	3.194e-02
LA139	0.000e+00	3.177e-02	3.170e-02	3.162e-02	3.143e-02	3.124e-02	3.106e-02	3.093e-02	3.078e-02	3.064e-02	3.050e-02	3.036e-02
BA140	0.000e+00	1.505e-02	8.998e-03	6.159e-03	3.025e-03	2.008e-03	1.490e-03	1.182e-03	9.785e-04	8.331e-04	7.237e-04	6.343e-04
LA140	0.000e+00	1.582e-03	1.212e-03	8.332e-04	4.025e-04	2.659e-04	1.979e-04	1.575e-04	1.308e-04	1.118e-04	9.745e-05	8.473e-05
CE140	0.000e+00	1.494e-02	2.173e-02	2.488e-02	2.799e-02	2.897e-02	2.922e-02	2.967e-02	2.932e-02	2.992e-02	2.959e-02	3.006e-02
CE141	0.000e+00	2.126e-02	1.625e-02	1.277e-02	7.831e-03	4.872e-03	3.639e-03	2.881e-03	2.382e-03	2.026e-03	1.760e-03	1.406e-03
PR141	0.000e+00	7.521e-03	1.256e-02	1.600e-02	2.138e-02	2.360e-02	2.469e-02	2.528e-02	2.561e-02	2.580e-02	2.591e-02	2.596e-02
CE142	0.000e+00	2.833e-02	2.878e-02	2.872e-02	2.855e-02	2.838e-02	2.822e-02	2.807e-02	2.793e-02	2.779e-02	2.766e-02	2.743e-02
CE143	0.000e+00	1.502e-03	5.415e-04	6.204e-04	3.012e-04	1.959e-04	1.440e-04	1.132e-04	9.230e-05	7.848e-05	6.785e-05	5.334e-05
PR143	0.000e+00	1.375e-02	8.509e-03	5.858e-03	2.222e-03	1.903e-03	1.401e-03	1.103e-03	9.048e-04	7.640e-04	6.593e-04	5.224e-04
ND143	0.000e+00	1.207e-02	1.897e-02	2.157e-02	2.362e-02	2.360e-02	2.308e-02	2.237e-02	2.155e-02	2.068e-02	1.982e-02	1.828e-02
CE144	0.000e+00	2.520e-02	2.445e-02	2.345e-02	2.079e-02	1.852e-02	1.659e-02	1.493e-02	1.358e-02	1.222e-02	1.112e-02	9.477e-03
ND144	0.000e+00	1.135e-03	2.281e-03	3.403e-03	6.533e-03	9.309e-03	1.178e-02	1.400e-02	1.602e-02	1.786e-02	1.953e-02	2.224e-02
ND145	0.000e+00	1.502e-02	1.898e-02	1.887e-02	1.853e-02	1.818e-02	1.785e-02	1.753e-02	1.721e-02	1.690e-02	1.659e-02	1.603e-02
ND146	0.000e+00	1.491e-02	1.493e-02	1.496e-02	1.506e-02	1.517e-02	1.529e-02	1.543e-02	1.558e-02	1.574e-02	1.590e-02	1.622e-02
NC147	0.000e+00	5.106e-03	2.928e-03	1.983e-03	9.804e-04	6.468e-04	4.815e-04	3.830e-04	3.100e-04	2.717e-04	2.387e-04	1.887e-04
PR147	0.000e+00	6.025e-03	7.772e-03	8.270e-03	8.017e-03	7.240e-03	6.491e-03	5.779e-03	5.130e-03	4.556e-03	4.083e-03	3.505e-03
SM147	0.000e+00	4.578e-05	1.400e-04	2.369e-04	5.050e-04	7.228e-04	8.935e-04	1.024e-03	1.115e-03	1.185e-03	1.227e-03	1.263e-03
ND148	0.000e+00	8.595e-03	8.604e-03	8.608e-03	8.618e-03	8.622e-03	8.625e-03	8.628e-03	8.631e-03	8.634e-03	8.636e-03	8.629e-03
SM148	0.000e+00	5.760e-05	2.129e-04	3.998e-04	5.066e-04	1.505e-03	1.938e-03	2.359e-03	2.700e-03	3.039e-03	3.390e-03	3.777e-03
ND150	0.000e+00	3.458e-03	3.490e-03	3.522e-03	3.510e-03	3.687e-03	3.754e-03	3.815e-03	3.873e-03	3.929e-03	3.982e-03	4.071e-03
SM150	0.000e+00	4.022e-03	5.239e-03	5.456e-03	5.710e-03	5.773e-03	5.818e-03	5.844e-03	5.855e-03	5.862e-03	5.870e-03	5.817e-03
SM151	0.000e+00	1.666e-03	1.409e-03	1.197e-03	8.107e-04	6.165e-04	5.010e-04	4.333e-04	3.817e-04	3.450e-04	3.176e-04	2.788e-04
SM152	0.000e+00	1.534e-03	2.294e-03	2.554e-03	2.981e-03	3.149e-03	3.202e-03	3.197e-03	3.141e-03	3.105e-03	3.038e-03	2.900e-03
EU153	0.000e+00	8.533e-04	9.585e-04	1.038e-03	1.265e-03	1.485e-03	1.680e-03	1.852e-03	2.002e-03	2.136e-03	2.243e-03	2.385e-03
CO154	0.000e+00	5.155e-05	1.037e-04	1.438e-04	2.470e-04	4.354e-04	6.340e-04	8.326e-04	9.577e-04	1.0564e-03	1.145e-03	1.2345e-03
SUMTCT	0.000e+00	9.834e-01	9.890e-01	9.901e-01	9.907e-01	9.905e-01	9.900e-01	9.894e-01	9.879e-01	9.879e-01	9.872e-01	9.857e-01
TOTAL	0.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00

OUTPUT UNIT = 11

FISSION PRODUCTS

* IRRADIATION OF ONE METRIC TON OF PWR-U FUEL *

POWER= 3.75000e+01 MW. BURNUP= 3.30000e+04 MWD. FLUX= 3.24e+14 N/CM^2-SEC

4 SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS

METRIC TON OF PWR-U FUEL

	0. S	3C.00	60.00	90.00	180.00	270.00	360.00	450.00	540.00	630.00	720.00	880.00
SE	0.000e+00	2.703e-03	2.686e-03	2.671e-03	2.634e-03	2.600e-03	2.560e-03	2.538e-03	2.510e-03	2.481e-03	2.454e-03	2.408e-03
BR	0.000e+00	1.682e-03	1.667e-03	1.658e-03	1.639e-03	1.623e-03	1.600e-03	1.593e-03	1.577e-03	1.564e-03	1.544e-03	1.504e-03
KR	0.000e+00	1.688e-02	1.857e-02	1.833e-02	1.778e-02	1.731e-02	1.690e-02	1.655e-02	1.619e-02	1.586e-02	1.556e-02	1.504e-02
RB	0.000e+00	1.721e-02	1.701e-02	1.681e-02	1.630e-02	1.585e-02	1.546e-02	1.511e-02	1.478e-02	1.446e-02	1.416e-02	1.365e-02
SR	0.000e+00	6.450e-02	6.010e-02	5.675e-02	5.017e-02	4.624e-02	4.361e-02	4.167e-02	4.006e-02	3.867e-02	3.747e-02	3.553e-02
Y	0.000e+00	2.434e-02	2.742e-02	2.665e-02	2.474e-02	2.328e-02	2.216e-02	2.128e-02	2.053e-02	1.987e-02	1.929e-02	1.826e-02
ZR	0.000e+00	1.532e-01	1.519e-01	1.507e-01	1.475e-01	1.446e-01	1.421e-01	1.399e-01	1.378e-01	1.359e-01	1.341e-01	1.310e-01
MB	0.000e+00	3.677e-03	5.738e-03	6.534e-03	6.260e-03	5.055e-03	4.013e-03	3.244e-03	2.684e-03	2.270e-03	1.956e-03	1.554e-03
MD	0.000e+00	9.234e-02	9.365e-02	9.535e-02	1.013e-01	1.058e-01	1.088e-01	1.107e-01	1.120e-01	1.129e-01	1.135e-01	1.140e-01
TC	0.000e+00	2.593e-02	2.778e-02	2.834e-02	2.876e-02	2.870e-02	2.853e-02	2.830e-02	2.802e-02	2.772e-02	2.741e-02	2.680e-02
RU	0.000e+00	7.473e-02	7.341e-02	7.257e-02	7.221e-02	7.303e-02	7.410e-02	7.526e-02	7.651e-02	7.780e-02	7.903e-02	8.121e-02
RM	0.000e+00	4.150e-03	6.615e-03	8.516e-03	1.192e-02	1.353e-02	1.532e-02	1.667e-02	1.768e-02	1.840e-02	1.893e-02	1.940e-02
PD	0.000e+00	9.166e-03	1.060e-02	1.188e-02	1.545e-02	1.881e-02	2.200e-02	2.505e-02	2.808e-02	3.107e-02	3.397e-02	3.680e-02
AG	0.000e+00	6.788e-04	7.750e-04	8.836e-04	1.187e-03	1.445e-03	1.661e-03	1.841e-03	2.003e-03	2.149e-03	2.274e-03	2.400e-03
CC	0.000e+00	1.144e-03	1.235e-03	1.311e-03	1.511e-03	1.706e-03	1.907e-03	2.115e-03	2.338e-03	2.576e-03	2.823e-03	3.000e-03
SM	0.000e+00	1.568e-03	1.969e-03	1.990e-03	2.071e-03	2.150e-03	2.221e-03	2.287e-03	2.353e-03	2.416e-03	2.474e-03	2.578e-03
YE	0.000e+00	1.443e-02	1.270e-02	1.217e-02	1.182e-02	1.186e-02	1.197e-02	1.211e-02	1.225e-02	1.240e-02	1.254e-02	1.278e-02
I	0.000e+00	1.107e-01	1.313e-01	1.380e-01	1.530e-01	1.637e-01	1.744e-01	1.850e-01	1.956e-01	2.061e-01	2.166e-01	2.271e-01
NE	0.000e+00	6.187e-02	6.671e-02	6.822e-02	7.003e-02	7.057e-02	7.077e-02	7.081e-02	7.074e-02	7.061e-02	7.045e-02	7.004e-02
CS	0.000e+00	4.688e-02	4.248e-02	3.958e-02	3.641e-02	3.535e-02	3.487e-02	3.463e-02	3.452e-02	3.450e-02	3.450e-02	3.450e-02
BA	0.000e+00	3.408e-02	3.308e-02	3.257e-02	3.185e-02	3.154e-02	3.130e-02	3.110e-02	3.093e-02	3.076e-02	3.061e-02	3.035e-02
LA	0.000e+00	9.466e-02	9.215e-02	9.044e-02	8.488e-02	8.093e-02	7.800e-02	7.566e-02	7.371e-02	7.204e-02	7.060e-02	6.842e-02
CE	0.000e+00	2.352e-02	2.119e-02	2.194e-02	2.435e-02	2.553e-02	2.611e-02	2.640e-02	2.653e-02	2.658e-02	2.658e-02	2.649e-02
PR	0.000e+00	6.433e-02	7.021e-02	7.294e-02	7.702e-02	7.935e-02	8.106e-02	8.241e-02	8.352e-02	8.442e-02	8.517e-02	8.629e-02
NO	0.000e+00	6.425e-03	8.264e-03	8.681e-03	8.302e-03	7.492e-03	6.889e-03	5.953e-03	5.255e-03	4.696e-03	4.189e-03	3.410e-03
PM	0.000e+00	9.257e-03	1.030e-02	1.091e-02	1.176e-02	1.252e-02	1.314e-02	1.364e-02	1.404e-02	1.436e-02	1.461e-02	1.494e-02
EU	0.000e+00	1.359e-03	1.264e-03	1.356e-03	1.645e-03	1.947e-03	2.246e-03	2.534e-03	2.812e-03	3.070e-03	3.280e-03	3.520e-03
GD	0.000e+00	1.402e-04	2.220e-04	2.763e-04	4.183e-04	5.485e-04	6.785e-04	8.173e-04	9.743e-04	1.154e-03	1.356e-03	1.633e-03
SUMTCT	0.000e+00	9.588e-01	9.988e-01	9.988e-01	9.988e-01	9.988e-01	9.988e-01	9.988e-01	9.988e-01	9.988e-01	9.988e-01	9.988e-01
TOTAL	0.000e+00	1.400e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00

Command File and Output Data

```

-1
-1
-1
BAS ONE METRIC TON CF PWR-U (4.15%) FUEL
LIP 0 0 0
LIB 0 0 2 3 219 220 221 9 3 0 1 9
PHO 0 0 0 0 10
DPTL 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8
DPTA 8 8 8 7 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8
DPTF 8 8 8 7 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8
INP -1 1 -1 -1 1 1
MOV -1 1 0 1.0
BUP
IRP 30 37.5 1 2 4 2
IRP 90 37.5 2 3 4 0
IRP 180 37.5 3 4 4 0
IRP 270 37.5 4 5 4 0
IRP 360 37.5 5 6 4 0
IRP 540 37.5 6 7 4 0
IRP 720 37.5 7 8 4 0
IRP 900 37.5 8 9 4 0
IRP 1080 37.5 9 10 4 0
IRP 1260 37.5 10 11 4 0
IRP 1333 37.5 11 12 4 0
BUP
TIT * IRRADIATION OF ONE METRIC TON OF PWR-U (4.15%) FUEL *
OUT -12 1 -1 0
ENC
2 $22340 376.0 92235C 41500.0 92238C 958124.0 0 0.0 FUEL ACTINIDES
4 030000 1.0 05000C 1.0 060000 89.4 070000 25.0 FUEL IMPUR
4 080000 134454.0 09000C 10.7 110000 15.0 120000 2.0 FUEL IMPUR
4 130000 16.7 14000C 12.1 150000 35.0 170000 5.3 FUEL IMPUR
4 200000 2.0 22000C 1.0 230000 3.0 240000 4.0 FUEL IMPUR
4 250000 1.7 26000C 18.0 270000 1.0 280000 24.0 FUEL IMPUR
4 290000 1.0 30000C 40.3 420000 10.0 470000 0.1 FUEL IMPUR
4 480000 25.0 49000C 2.0 500000 4.0 640000 2.5 FUEL IMPUR
4 740000 2.0 82000C 1.0 830000 0.4 C 0.0 FUEL IMPUR
0

```

9 IRRADIATION OF ONE METRIC TON OF PHR-U (4.15Z) FUEL #
 POWER= 3.75000e+01 MW, BURNUP= 4.99875e+04 MWD, FLUX= 3.10e+14 N/CM^2-SEC
 REACTIVITY AND BURNUP DATA
 BASIS= METRIC TON OF PHR-U (4.15Z) FUEL

	0. S	30.00	90.00	180.00	270.00	360.00	540.00	720.00	900.00	1080.00	1260.00	1333.00
TIME, SEC	0.00e+00	2.59e+06	7.78e+06	1.56e+07	2.33e+07	3.11e+07	4.67e+07	6.22e+07	7.78e+07	9.33e+07	1.09e+08	1.15e+08
NEUT. FLUX	0.00e+00	2.56e+14	2.57e+14	2.59e+14	2.63e+14	2.68e+14	2.80e+14	2.98e+14	3.21e+14	3.45e+14	3.70e+14	3.88e+14
SP POW. MW	0.00e+00	3.75e+01	3.75e+01	3.75e+01	3.75e+01	3.75e+01	3.75e+01	3.75e+01	3.75e+01	3.75e+01	3.75e+01	3.75e+01
BURNUP. MWD	0.00e+00	1.13e+03	2.25e+03	3.38e+03	3.38e+03	3.38e+03	3.38e+03	3.38e+03	3.38e+03	3.38e+03	3.38e+03	3.38e+03
K INFINITY	0.	1.39092	1.34777	1.32885	1.28653	1.24635	1.17900	1.11439	1.05839	1.01094	0.96815	0.95071
NEUT PROD	0.00e+00	1.13e+04	1.13e+04	1.13e+04	1.11e+04	1.09e+04	1.04e+04	9.77e+03	9.19e+03	8.66e+03	8.20e+03	8.04e+03
NEUT DEST	0.00e+00	8.11e+03	8.29e+03	8.49e+03	8.65e+03	8.75e+03	8.79e+03	8.77e+03	8.69e+03	8.57e+03	8.49e+03	8.46e+03
TOT BURNUP	0.00e+00	5.00e+04	5.00e+04	5.00e+04	5.00e+04	5.00e+04	5.00e+04	5.00e+04	5.00e+04	5.00e+04	5.00e+04	5.00e+04
AVG N FLUX	0.00e+00	3.10e+14	3.10e+14	3.10e+14	3.10e+14	3.10e+14	3.10e+14	3.10e+14	3.10e+14	3.10e+14	3.10e+14	3.10e+14
AVG SP POW	0.00e+00	3.75e+01	3.75e+01	3.75e+01	3.75e+01	3.75e+01	3.75e+01	3.75e+01	3.75e+01	3.75e+01	3.75e+01	3.75e+01

SIZE OF MMAX(I): MMAX= 1 8= 568 MMAX= 2 8= 253 MMAX= 3 8= 71 MMAX= 4 8= 25 MMAX= 5 8= 32 MMAX= 6 8= 29
 MMAX= 7 8= 24 MMAX= 8 8= 0 MMAX= 9 8= 0 MMAX= 10 8= 0 MMAX= 11 8= 0 MMAX= 12 8= 0

THE NUMBER OF NON-ZERO TERMS IN A=4912
 THE NUMBER OF NON-ZERO FISSION PRODUCT YIELDS=3242
 ILITE= 0 IACT= 125 IFP= 879 ITOT=1008
 THE NUMBER OF NON-ZERO NATURAL ABUNDANCES= 154
 THE NUMBER OF NON-ZERO FICTON YIELDS= 0
 THE MAXIMUM NUMBER OF TERMS IN AP= 2184

* IRRADIATION OF ONE METRIC TON OF PWR-U (4.15%) FUEL *

POWER= 3.75000e+01 MW, BURNUP= 4.99875e+04 MWD, FLUX= 3.10e+14 N/CM^2-SEC

ACTINIDES+DAUGHTERS

4 SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS
METRIC TON OF PWR-U (4.15%) FUEL

	0. S	30.00	90.00	180.00	270.00	360.00	540.00	720.00	900.00	1080.00	1260.00	1333.00
U235	4.201e-02	4.670e-02	3.920e-02	3.471e-02	3.149e-02	2.849e-02	2.308e-02	1.840e-02	1.438e-02	1.098e-02	8.198e-03	7.232e-03
U236	0.000e+00	2.571e-04	7.454e-04	1.418e-03	2.029e-03	2.587e-03	3.545e-03	4.368e-03	5.009e-03	5.504e-03	5.856e-03	5.561e-03
U238	9.576e-01	9.581e-01	9.591e-01	9.605e-01	9.619e-01	9.633e-01	9.659e-01	9.682e-01	9.702e-01	9.718e-01	9.730e-01	9.733e-01
PU239	0.000e+00	4.517e-04	1.449e-03	2.562e-03	3.381e-03	3.993e-03	4.821e-03	5.298e-03	5.589e-03	5.820e-03	5.989e-03	6.045e-03
PU240	0.000e+00	9.532e-06	8.157e-05	2.687e-04	4.996e-04	7.469e-04	1.251e-03	1.657e-03	2.082e-03	2.432e-03	2.729e-03	2.838e-03
PU241	0.000e+00	3.562e-07	9.413e-06	6.052e-05	1.646e-04	3.061e-04	6.378e-04	1.001e-03	1.324e-03	1.560e-03	1.750e-03	1.811e-03
SUMTCT	9.576e-01	9.596e-01	9.595e-01	9.595e-01	9.595e-01	9.594e-01	9.593e-01	9.590e-01	9.586e-01	9.581e-01	9.575e-01	9.572e-01
TOTAL	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00

* IRRADIATION OF ONE METRIC TON OF PWR-U (4.15%) FUEL *

POWER= 3.75000e+01 MW, BURNUP= 4.99875e+04 MWD, FLUX= 3.10e+14 N/CM^2-SEC

ACTINIDES+DAUGHTERS

4 SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS
METRIC TON OF PWR-U (4.15%) FUEL

	0. S	30.00	90.00	180.00	270.00	360.00	540.00	720.00	900.00	1080.00	1260.00	1333.00
U	1.000e+00	9.594e-01	9.984e-01	9.970e-01	9.958e-01	9.947e-01	9.929e-01	9.913e-01	9.898e-01	9.885e-01	9.872e-01	9.867e-01
PU	0.000e+00	5.620e-04	1.541e-03	2.895e-03	4.061e-03	5.082e-03	6.831e-03	8.267e-03	9.486e-03	1.057e-02	1.156e-02	1.191e-02
SUMTOT	1.000e+00	9.599e-01	9.999e-01	9.999e-01	9.999e-01	9.998e-01	9.997e-01	9.995e-01	9.993e-01	9.991e-01	9.988e-01	9.987e-01
TOTAL	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00

FISSION PRODUCTS

* IRRADIATION OF ONE METRIC TON OF PWR-U (4.15%) FUEL *

POWER= 3.75000e+01 MW, BURNUP= 4.99875e+04 MWD, FLUX= 3.10e+14 N/CM^2-SEC

4 SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS

METRIC TON OF PWR-U (4.15%) FUEL

	0. S	30.00	90.00	180.00	270.00	360.00	540.00	720.00	900.00	1080.00	1260.00	1333.00
BR 01	0.000e+00	1.655e-03	1.056e-03	1.043e-03	1.031e-03	1.019e-03	9.961e-04	9.723e-04	9.481e-04	9.238e-04	8.994e-04	8.756e-04
SE 02	0.000e+00	1.554e-03	1.635e-03	1.610e-03	1.587e-03	1.567e-03	1.530e-03	1.495e-03	1.462e-03	1.430e-03	1.400e-03	1.380e-03
CR 03	0.000e+00	2.530e-03	2.578e-03	2.488e-03	2.402e-03	2.319e-03	2.262e-03	2.011e-03	1.862e-03	1.718e-03	1.578e-03	1.523e-03
KR 04	0.000e+00	5.000e-03	5.041e-03	4.987e-03	4.933e-03	4.907e-03	4.852e-03	4.801e-03	4.774e-03	4.747e-03	4.722e-03	4.713e-03
BR 05	0.000e+00	1.304e-03	1.284e-03	1.269e-03	1.259e-03	1.185e-03	1.128e-03	1.076e-03	1.027e-03	9.808e-04	9.371e-04	9.010e-04
BR 06	0.000e+00	4.643e-03	4.797e-03	4.768e-03	4.622e-03	4.545e-03	4.409e-03	4.282e-03	4.162e-03	4.049e-03	3.946e-03	3.857e-03
KR 07	0.000e+00	9.763e-03	9.584e-03	9.350e-03	9.142e-03	8.950e-03	8.628e-03	8.327e-03	8.046e-03	7.782e-03	7.530e-03	7.420e-03
BR 08	0.000e+00	1.769e-02	1.742e-02	1.730e-02	1.678e-02	1.627e-02	1.565e-02	1.508e-02	1.454e-02	1.404e-02	1.356e-02	1.338e-02
SR 09	0.000e+00	1.897e-02	1.297e-02	8.021e-03	5.452e-03	3.988e-03	2.447e-03	1.692e-03	1.249e-03	9.616e-04	7.593e-04	7.000e-04
Y 09	0.000e+00	4.191e-03	9.754e-03	1.411e-02	1.615e-02	1.715e-02	1.785e-02	1.783e-02	1.755e-02	1.716e-02	1.671e-02	1.652e-02
SR 90	0.000e+00	2.761e-02	2.703e-02	2.625e-02	2.556e-02	2.494e-02	2.382e-02	2.278e-02	2.181e-02	2.090e-02	2.002e-02	1.968e-02
ZR 90	0.000e+00	6.485e-05	1.194e-04	1.969e-04	2.722e-04	3.455e-04	4.867e-04	6.204e-04	7.471e-04	8.673e-04	9.812e-04	1.026e-03
Y 91	0.000e+00	2.541e-02	1.696e-02	1.103e-02	7.712e-03	5.735e-03	3.882e-03	2.506e-03	1.871e-03	1.458e-03	1.167e-03	1.060e-03
ZR 91	0.000e+00	4.421e-03	1.075e-02	1.613e-02	1.891e-02	2.035e-02	2.163e-02	2.186e-02	2.170e-02	2.136e-02	2.093e-02	2.073e-02
ZR 92	0.000e+00	2.855e-02	2.867e-02	2.817e-02	2.769e-02	2.725e-02	2.646e-02	2.573e-02	2.504e-02	2.440e-02	2.378e-02	2.353e-02
ZR 93	0.000e+00	3.698e-02	1.103e-02	3.042e-02	2.019e-02	2.979e-02	2.904e-02	2.832e-02	2.763e-02	2.697e-02	2.633e-02	2.607e-02
ZR 94	0.000e+00	3.647e-02	2.023e-02	2.991e-02	2.961e-02	2.933e-02	2.887e-02	2.843e-02	2.802e-02	2.763e-02	2.726e-02	2.712e-02
BR 95	0.000e+00	2.692e-02	1.997e-02	1.997e-02	2.814e-02	2.750e-02	2.734e-02	2.786e-03	2.786e-03	2.761e-03	2.739e-03	2.729e-03
ZR 95	0.000e+00	3.020e-03	6.533e-03	6.250e-03	5.100e-03	4.065e-03	2.734e-03	2.000e-03	1.556e-03	1.262e-03	1.056e-03	9.642e-04
PC 95	0.000e+00	8.780e-04	4.799e-03	1.113e-02	1.571e-02	1.872e-02	2.197e-02	2.334e-02	2.388e-02	2.400e-02	2.386e-02	2.375e-02
ZR 96	0.000e+00	3.101e-02	1.084e-02	3.029e-02	2.041e-02	3.022e-02	2.988e-02	2.955e-02	2.933e-02	2.892e-02	2.862e-02	2.851e-02
PC 96	0.000e+00	4.283e-06	1.994e-05	7.599e-05	1.616e-04	2.667e-04	5.137e-04	7.938e-04	1.100e-03	1.431e-03	1.781e-03	1.928e-03
PC 97	0.000e+00	2.620e-02	2.884e-02	2.893e-02	2.891e-02	2.886e-02	2.873e-02	2.859e-02	2.841e-02	2.825e-02	2.808e-02	2.801e-02
MC 98	0.000e+00	2.511e-02	2.912e-02	2.914e-02	2.915e-02	2.916e-02	2.917e-02	2.917e-02	2.917e-02	2.917e-02	2.916e-02	2.916e-02
MC 99	0.000e+00	3.548e-03	1.315e-03	6.532e-04	4.338e-04	3.245e-04	2.122e-04	1.588e-04	1.270e-04	1.055e-04	9.114e-05	8.812e-05
TC 99	0.000e+00	2.555e-02	2.827e-02	2.873e-02	2.855e-02	2.855e-02	2.810e-02	2.754e-02	2.691e-02	2.622e-02	2.549e-02	2.518e-02
PC100	0.000e+00	3.134e-02	2.144e-02	3.156e-02	2.166e-02	3.176e-02	3.187e-02	3.197e-02	3.204e-02	3.210e-02	3.215e-02	3.217e-02
RU100	0.000e+00	8.272e-05	2.745e-04	5.636e-04	8.552e-04	1.152e-03	1.771e-03	2.428e-03	3.129e-03	3.873e-03	4.654e-03	5.480e-03
RU101	0.000e+00	2.567e-02	2.578e-02	2.599e-02	2.598e-02	2.604e-02	2.613e-02	2.618e-02	2.620e-02	2.618e-02	2.614e-02	2.611e-02
RU102	0.000e+00	2.188e-02	2.221e-02	2.265e-02	2.305e-02	2.342e-02	2.410e-02	2.476e-02	2.540e-02	2.604e-02	2.667e-02	2.693e-02
RU103	0.000e+00	1.190e-02	8.689e-03	5.511e-03	4.067e-03	3.222e-03	2.298e-03	1.826e-03	1.552e-03	1.357e-03	1.217e-03	1.164e-03
RM103	0.000e+00	3.456e-03	8.216e-03	1.157e-02	1.312e-02	1.389e-02	1.442e-02	1.420e-02	1.386e-02	1.323e-02	1.250e-02	1.218e-02
RU104	0.000e+00	1.555e-02	1.119e-02	1.201e-02	1.273e-02	1.338e-02	1.453e-02	1.559e-02	1.657e-02	1.750e-02	1.838e-02	1.873e-02
PD104	0.000e+00	3.214e-05	2.397e-04	7.312e-04	1.323e-03	1.964e-03	3.361e-03	4.799e-03	6.316e-03	7.870e-03	9.421e-03	1.056e-02
PD105	0.000e+00	5.430e-03	3.300e-03	7.100e-03	7.835e-03	8.442e-03	9.486e-03	1.040e-02	1.123e-02	1.198e-02	1.266e-02	1.292e-02
RU106	0.000e+00	2.669e-03	3.264e-03	3.705e-03	4.026e-03	4.258e-03	4.548e-03	4.726e-03	4.832e-03	4.879e-03	4.892e-03	4.892e-03
PC106	0.000e+00	4.282e-04	6.948e-04	1.099e-03	1.540e-03	2.007e-03	3.002e-03	4.051e-03	5.163e-03	6.264e-03	7.406e-03	7.873e-03
PC107	0.000e+00	1.543e-03	1.987e-03	2.575e-03	3.094e-03	3.570e-03	4.429e-03	5.229e-03	5.983e-03	6.688e-03	7.352e-03	7.612e-03
PD108	0.000e+00	8.593e-04	1.175e-03	1.592e-03	1.965e-03	2.307e-03	2.944e-03	3.501e-03	4.045e-03	4.552e-03	5.021e-03	5.211e-03
AG109	0.000e+00	5.625e-04	7.039e-04	9.505e-04	1.237e-03	1.337e-03	1.628e-03	1.867e-03	2.060e-03	2.210e-03	2.321e-03	2.363e-03
PD110	0.000e+00	4.634e-04	4.516e-04	5.691e-04	6.760e-04	7.751e-04	9.587e-04	1.135e-03	1.308e-03	1.469e-03	1.627e-03	1.650e-03
CD110	0.000e+00	4.160e-06	2.485e-05	6.462e-05	1.172e-04	1.816e-04	3.442e-04	5.511e-04	8.031e-04	1.099e-03	1.435e-03	1.582e-03
TE117	0.000e+00	7.255e-04	8.984e-04	1.006e-03	1.081e-03	1.140e-03	1.230e-03	1.299e-03	1.354e-03	1.399e-03	1.436e-03	1.459e-03
TE118	0.000e+00	2.278e-03	2.347e-03	2.433e-03	2.506e-03	2.569e-03	2.674e-03	2.763e-03	2.841e-03	2.918e-03	2.979e-03	3.030e-03
TE119	0.000e+00	3.446e-03	2.724e-03	3.961e-03	4.115e-03	4.229e-03	4.353e-03	4.509e-03	4.594e-03	4.657e-03	4.703e-03	4.718e-03
TE120	0.000e+00	7.519e-03	8.063e-03	8.247e-03	8.405e-03	8.542e-03	8.771e-03	8.967e-03	9.140e-03	9.296e-03	9.446e-03	9.499e-03
TE121	0.000e+00	5.212e-03	1.916e-03	9.756e-04	6.375e-04	4.974e-04	3.414e-04	2.519e-04	2.041e-04	1.723e-04	1.499e-04	1.456e-04
TE122	0.000e+00	9.220e-03	1.250e-02	1.326e-02	1.332e-02	1.329e-02	1.270e-02	1.207e-02	1.137e-02	1.064e-02	9.895e-03	9.583e-03
TE132	0.000e+00	3.383e-03	1.142e-03	5.753e-04	3.851e-04	2.503e-04	1.921e-04	1.453e-04	1.172e-04	9.853e-05	8.536e-05	8.294e-05
TE132	0.000e+00	1.443e-02	2.112e-02	2.235e-02	2.315e-02	2.383e-02	2.506e-02	2.622e-02	2.735e-02	2.847e-02	2.956e-02	2.998e-02
TE133	0.000e+00	1.395e-03	4.648e-04	2.310e-04	1.534e-04	1.147e-04	7.495e-05	5.601e-05	4.471e-05	3.723e-05	3.194e-05	3.087e-05

FISSION PRODUCTS

* IRRADIATION OF ONE METRIC TON OF PHR-U (4.158) FUEL *

POWER= 3.75000e+01 MW, BURNUP= 4.99875e+04 MWD, FLUX= 3.10e+16 N/CM^2-SEC
 4 SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS
 METRIC TON OF PHR-U (4.158) FUEL

	0. S	30.00	90.00	180.00	270.00	360.00	540.00	720.00	900.00	1080.00	1260.00	1333.00
XE133	0.000e+00	7.892e-03	2.807e-03	1.395e-03	9.268e-04	6.933e-04	4.534e-04	3.390e-04	2.707e-04	2.256e-04	1.938e-04	1.873e-04
CS133	0.000e+00	2.195e-02	2.986e-02	3.119e-02	3.138e-02	3.128e-02	3.077e-02	3.040e-02	2.920e-02	2.71e-02	2.728e-02	2.686e-02
XE134	0.000e+00	3.812e-02	2.817e-02	3.815e-02	1.811e-02	3.808e-02	3.804e-02	3.800e-02	2.797e-02	3.795e-02	3.792e-02	3.791e-02
CS134	0.000e+00	7.592e-05	2.485e-04	7.140e-04	1.032e-03	1.368e-03	1.953e-03	2.483e-03	2.948e-03	3.407e-03	3.794e-03	3.539e-03
BA134	0.000e+00	6.327e-07	9.285e-06	3.940e-05	8.838e-05	1.548e-04	3.370e-04	5.775e-04	8.703e-04	1.210e-03	1.589e-03	1.753e-03
CS135	0.000e+00	9.121e-03	5.251e-03	9.301e-03	5.317e-03	9.319e-03	9.291e-03	9.260e-03	9.243e-03	9.255e-03	9.310e-03	9.345e-03
XE136	0.000e+00	5.488e-02	5.533e-02	5.563e-02	5.587e-02	5.610e-02	5.655e-02	5.700e-02	5.745e-02	5.788e-02	5.831e-02	5.848e-02
CS137	0.000e+00	3.434e-02	2.035e-02	3.036e-02	2.035e-02	3.034e-02	3.028e-02	3.021e-02	3.013e-02	3.004e-02	2.994e-02	2.990e-02
BA137	0.000e+00	3.147e-05	8.944e-05	1.765e-04	2.835e-04	3.504e-04	5.242e-04	6.969e-04	8.688e-04	1.039e-03	1.209e-03	1.277e-03
BA138	0.000e+00	3.249e-02	2.539e-02	3.521e-02	2.506e-02	3.292e-02	3.268e-02	3.247e-02	3.228e-02	3.211e-02	3.194e-02	3.180e-02
LA139	0.000e+00	3.183e-02	3.176e-02	3.169e-02	3.145e-02	3.131e-02	3.108e-02	3.082e-02	3.060e-02	3.037e-02	3.015e-02	3.006e-02
BA140	0.000e+00	1.510e-02	6.179e-03	3.070e-03	2.025e-03	1.506e-03	9.677e-04	7.163e-04	5.667e-04	4.681e-04	3.940e-04	3.856e-04
LA140	0.000e+00	1.532e-03	8.161e-04	4.049e-04	2.677e-04	1.995e-04	1.288e-04	9.522e-05	7.642e-05	6.361e-05	5.463e-05	5.317e-05
CE140	0.000e+00	1.495e-02	2.473e-02	2.795e-02	2.895e-02	2.948e-02	2.980e-02	2.992e-02	2.999e-02	3.005e-02	3.009e-02	3.011e-02
CE141	0.000e+00	2.131e-02	1.284e-02	7.299e-03	4.916e-03	3.669e-03	2.385e-03	1.764e-03	1.392e-03	1.148e-03	9.741e-04	9.293e-04
PR141	0.000e+00	7.541e-03	1.607e-02	2.150e-02	2.376e-02	2.487e-02	2.590e-02	2.635e-02	2.635e-02	2.630e-02	2.618e-02	2.611e-02
CE142	0.000e+00	2.882e-02	2.882e-02	2.869e-02	2.835e-02	2.842e-02	2.819e-02	2.796e-02	2.774e-02	2.754e-02	2.734e-02	2.726e-02
CE143	0.000e+00	1.505e-03	6.254e-04	3.051e-04	1.995e-04	1.471e-04	9.384e-05	6.854e-05	5.354e-05	4.370e-05	3.679e-05	3.528e-05
PR143	0.000e+00	1.278e-02	5.945e-03	2.959e-03	1.936e-03	1.430e-03	9.209e-04	6.723e-04	5.250e-04	4.283e-04	3.604e-04	3.414e-04
NC143	0.000e+00	1.212e-02	2.168e-02	2.405e-02	2.426e-02	2.394e-02	2.280e-02	2.140e-02	1.992e-02	1.842e-02	1.694e-02	1.633e-02
CE144	0.000e+00	2.563e-02	2.364e-02	2.103e-02	1.880e-02	1.688e-02	1.376e-02	1.140e-02	9.566e-03	8.136e-03	6.998e-03	6.609e-03
MD144	0.000e+00	1.104e-03	3.286e-03	6.277e-03	8.925e-03	1.128e-02	1.537e-02	1.873e-02	2.155e-02	2.398e-02	2.605e-02	2.686e-02
MD145	0.000e+00	1.507e-02	1.899e-02	1.871e-02	1.842e-02	1.813e-02	1.759e-02	1.704e-02	1.650e-02	1.595e-02	1.539e-02	1.516e-02
NC146	0.000e+00	1.492e-02	1.498e-02	1.507e-02	1.517e-02	1.528e-02	1.553e-02	1.581e-02	1.612e-02	1.648e-02	1.682e-02	1.657e-02
MD147	0.000e+00	5.108e-03	1.987e-03	9.853e-04	6.513e-04	4.854e-04	3.134e-04	2.331e-04	1.855e-04	1.541e-04	1.321e-04	1.283e-04
PR147	0.000e+00	6.644e-03	8.355e-03	8.172e-03	7.499e-03	6.735e-03	5.394e-03	4.333e-03	3.500e-03	2.849e-03	2.344e-03	2.173e-03
SM147	0.000e+00	4.594e-05	2.391e-04	5.135e-04	7.464e-04	9.227e-04	1.194e-03	1.336e-03	1.389e-03	1.380e-03	1.359e-03	1.257e-03
NC148	0.000e+00	8.576e-03	4.597e-03	8.602e-03	8.602e-03	8.603e-03	8.603e-03	8.603e-03	8.603e-03	8.603e-03	8.603e-03	8.603e-03
SM148	0.000e+00	5.432e-05	4.049e-04	9.641e-04	1.467e-03	1.913e-03	2.711e-03	3.339e-03	3.847e-03	4.262e-03	4.595e-03	4.709e-03
SM149	0.000e+00	1.191e-03	4.690e-04	2.420e-04	1.644e-04	1.245e-04	8.239e-05	6.073e-05	4.729e-05	3.821e-05	3.183e-05	2.986e-05
MD150	0.000e+00	3.425e-03	3.475e-03	3.542e-03	3.602e-03	3.656e-03	3.754e-03	3.845e-03	3.931e-03	4.011e-03	4.070e-03	4.117e-03
SP150	0.000e+00	3.780e-03	4.964e-03	5.362e-03	5.523e-03	5.615e-03	5.718e-03	5.731e-03	5.735e-03	5.693e-03	5.617e-03	5.577e-03
SM151	0.000e+00	1.732e-03	1.322e-03	9.220e-04	7.185e-04	5.907e-04	4.648e-04	3.694e-04	2.844e-04	2.444e-04	2.585e-04	2.495e-04
SM152	0.000e+00	1.827e-03	2.360e-03	2.746e-03	2.938e-03	3.003e-03	2.984e-03	2.830e-03	2.750e-03	2.620e-03	2.438e-03	2.394e-03
EU153	0.000e+00	8.453e-04	1.013e-03	1.216e-03	1.413e-03	1.596e-03	1.917e-03	2.188e-03	2.352e-03	2.476e-03	2.532e-03	2.539e-03
EU154	0.000e+00	1.813e-05	5.931e-05	1.261e-04	1.995e-04	2.781e-04	4.451e-04	6.128e-04	7.695e-04	9.049e-04	1.012e-03	1.046e-03
GD156	0.000e+00	5.711e-05	1.272e-04	2.114e-04	2.862e-04	3.600e-04	4.458e-04	5.416e-04	6.489e-04	7.695e-04	8.920e-04	9.920e-04
GD156	0.000e+00	9.670e-01	9.910e-01	9.919e-01	9.919e-01	9.919e-01	9.919e-01	9.919e-01	9.919e-01	9.919e-01	9.919e-01	9.919e-01
SUMTET	0.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00
TOTAL	0.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00

FISSION PRODUCTS

* IRRADIATION OF ONE METRIC TON OF PWR-U (4.15%) FUEL *

POWER= 3.75000E+01 MW, BURNUP= 4.99875E+04 MWD, FLUX= 3.10E+14 N/CM^2-SEC
 4 SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS
 METRIC TON OF PWR-U (4.15%) FUEL

	0. S	30.00	90.00	180.00	270.00	360.00	540.00	720.00	900.00	1080.00	1260.00	1333.00
SE	0.000E+00	2.110E-03	2.689E-03	2.660E-03	2.632E-03	2.607E-03	2.559E-03	2.513E-03	2.467E-03	2.424E-03	2.382E-03	2.350E-03
SR	0.000E+00	1.084E-03	1.063E-03	1.047E-03	1.033E-03	1.021E-03	9.971E-04	9.731E-04	9.487E-04	9.243E-04	8.999E-04	8.901E-04
RR	0.000E+00	1.898E-02	1.856E-02	1.811E-02	1.773E-02	1.740E-02	1.680E-02	1.626E-02	1.575E-02	1.528E-02	1.482E-02	1.450E-02
RB	0.000E+00	1.732E-02	1.705E-02	1.665E-02	1.629E-02	1.597E-02	1.541E-02	1.488E-02	1.438E-02	1.393E-02	1.349E-02	1.320E-02
SR	0.000E+00	6.497E-02	5.764E-02	5.139E-02	4.770E-02	4.525E-02	4.195E-02	3.958E-02	3.763E-02	3.593E-02	3.438E-02	3.379E-02
Y	0.000E+00	2.651E-02	2.702E-02	2.529E-02	2.396E-02	2.295E-02	2.148E-02	2.037E-02	1.945E-02	1.864E-02	1.790E-02	1.761E-02
ZR	0.000E+00	1.537E-01	1.519E-01	1.494E-01	1.470E-01	1.449E-01	1.413E-01	1.381E-01	1.352E-01	1.324E-01	1.298E-01	1.288E-01
NR	0.000E+00	3.632E-03	6.565E-03	6.307E-03	5.112E-03	4.074E-03	2.740E-03	2.004E-03	1.558E-03	1.265E-03	1.056E-03	9.855E-04
MC	0.000E+00	9.343E-02	5.554E-02	1.615E-01	1.060E-01	1.091E-01	1.125E-01	1.140E-01	1.147E-01	1.151E-01	1.151E-01	1.151E-01
YC	0.000E+00	2.593E-02	2.838E-02	2.878E-02	2.874E-02	2.858E-02	2.812E-02	2.755E-02	2.692E-02	2.623E-02	2.550E-02	2.519E-02
RU	0.000E+00	7.402E-02	7.143E-02	7.041E-02	7.072E-02	7.148E-02	7.339E-02	7.552E-02	7.769E-02	7.983E-02	8.196E-02	8.233E-02
RM	0.000E+00	4.101E-03	6.397E-03	1.168E-02	1.320E-02	1.396E-02	1.447E-02	1.454E-02	1.390E-02	1.327E-02	1.254E-02	1.221E-02
PD	0.000E+00	8.693E-03	1.086E-02	1.371E-02	1.644E-02	1.907E-02	2.415E-02	2.912E-02	3.403E-02	3.882E-02	4.350E-02	4.536E-02
AG	0.000E+00	6.692E-04	7.513E-04	9.826E-04	1.186E-03	1.363E-03	1.656E-03	1.898E-03	2.093E-03	2.269E-03	2.365E-03	2.498E-03
CO	0.000E+00	1.659E-03	1.197E-03	1.350E-03	1.500E-03	1.655E-03	1.900E-03	2.368E-03	2.792E-03	3.260E-03	3.768E-03	3.964E-03
SM	0.000E+00	1.622E-03	1.873E-03	1.932E-03	1.994E-03	2.052E-03	2.106E-03	2.261E-03	2.357E-03	2.450E-03	2.540E-03	2.576E-03
TE	0.000E+00	1.433E-02	1.202E-02	1.158E-02	1.157E-02	1.164E-02	1.186E-02	1.210E-02	1.234E-02	1.257E-02	1.279E-02	1.288E-02
I	0.000E+00	1.136E-02	7.197E-03	6.270E-03	6.071E-03	6.029E-03	6.041E-03	6.140E-03	6.217E-03	6.281E-03	6.335E-03	6.378E-03
XE	0.000E+00	1.289E-01	1.301E-01	1.309E-01	1.315E-01	1.320E-01	1.330E-01	1.339E-01	1.348E-01	1.356E-01	1.364E-01	1.367E-01
CS	0.000E+00	6.377E-02	6.986E-02	7.159E-02	7.213E-02	7.232E-02	7.231E-02	7.261E-02	7.156E-02	7.099E-02	7.035E-02	7.007E-02
BA	0.000E+00	4.877E-02	3.976E-02	3.662E-02	3.559E-02	3.512E-02	3.478E-02	3.481E-02	3.502E-02	3.534E-02	3.574E-02	3.594E-02
LA	0.000E+00	3.414E-02	3.268E-02	3.206E-02	3.175E-02	3.153E-02	3.130E-02	3.093E-02	3.068E-02	3.045E-02	3.022E-02	3.012E-02
CE	0.000E+00	9.266E-02	5.065E-02	8.528E-02	8.146E-02	7.859E-02	7.422E-02	7.111E-02	6.873E-02	6.691E-02	6.544E-02	6.494E-02
PR	0.000E+00	2.157E-02	2.210E-02	2.450E-02	2.372E-02	2.633E-02	2.686E-02	2.694E-02	2.683E-02	2.674E-02	2.655E-02	2.645E-02
MD	0.000E+00	6.534E-02	7.303E-02	7.730E-02	7.975E-02	8.155E-02	8.423E-02	8.606E-02	8.734E-02	8.825E-02	8.888E-02	8.905E-02
PM	0.000E+00	6.234E-03	8.749E-03	8.452E-03	7.999E-03	6.933E-03	5.511E-03	4.461E-03	3.607E-03	2.939E-03	2.422E-03	2.249E-03
SM	0.000E+00	9.176E-03	1.028E-02	1.134E-02	1.213E-02	1.278E-02	1.381E-02	1.447E-02	1.487E-02	1.509E-02	1.517E-02	1.516E-02
EU	0.000E+00	1.138E-03	1.308E-03	1.555E-03	1.819E-03	2.085E-03	2.606E-03	3.076E-03	3.477E-03	3.792E-03	4.013E-03	4.074E-03
GO	0.000E+00	1.487E-04	2.459E-04	3.601E-04	4.632E-04	5.648E-04	8.095E-04	1.112E-03	1.496E-03	1.976E-03	2.554E-03	2.791E-03
SUMTOT	0.000E+00	9.588E-01	9.989E-01	9.989E-01	9.989E-01	9.989E-01	9.989E-01	9.989E-01	9.989E-01	9.989E-01	9.989E-01	9.989E-01
TOTAL	0.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

Command File and Output Data

```

-1
-1
-1
BAS CNE METRIC TON OF BWR-U FUEL
LIP 0 0 0
LIB 0 0 2 3 251 252 253 5 3 0 1 4
PHO 0 0 0 10
OPTL 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8
OPTA 8 8 8 7 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8
OPTF 8 8 8 7 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8
INP -1 1 -1 -1 1 1
MOV -1 1 0 1.0
BLP
IRP 30 25.9 1 2 4 2
IRP 60 25.9 2 3 4 0
IRP 90 25.9 3 4 4 0
IRP 180 25.9 4 5 4 0
IRP 270 25.9 5 6 4 0
IRP 360 25.9 6 7 4 0
IRP 450 25.9 7 8 4 0
IRP 540 25.9 8 9 4 0
IRP 720 25.9 9 10 4 0
IRP 900 25.9 10 11 4 0
IRP 1062 25.9 11 12 4 0
BLP
TIT * IRRADIATION OF CNE METRIC TON OF BWR-U FUEL *
OUT -12 1 -1 0
ENC
2 922340 247.0 92235C 27500.0 922380 972253.0 0 0.0 FUEL ACTINICES
4 030000 1.0 050000 1.0 060000 89.4 070000 25.0 FUEL IMPUR
4 080000 134454.0 090000 10.7 110000 15.0 120000 2.0 FUEL IMPUR
4 130000 16.7 140000 12.1 150000 35.0 170000 5.3 FUEL IMPUR
4 200000 2.0 220000 1.0 230000 3.0 240000 4.0 FUEL IMPUR
4 250000 1.7 260000 18.0 270000 1.0 280000 24.0 FUEL IMPUR
4 290000 1.0 300000 40.3 420000 10.0 470000 0.1 FUEL IMPUR
4 480000 25.0 490000 2.0 500000 4.0 640000 2.5 FUEL IMPUR
4 740000 2.0 820000 1.0 830000 0.4 6 0.0 FUEL IMPUR
0

```

OUTPUT UNIT = 11

* IRRADIATION OF ONE METRIC TON OF BWR-U FUEL *
 POWER= 2.59000e+01 MW, BURNUP= 2.75050e+04 MWD, FLUX= 2.35e+14 N/CM^2-SEC
 REACTIVITY AND BURNUP DATA
 BASIS= METRIC TON OF BWR-U FUEL

	0.5	30.00	60.00	90.00	180.00	270.00	360.00	450.00	540.00	720.00	900.00	1062.00
TIME, SEC	0.00e+00	2.59e+06	5.18e+06	7.78e+06	1.56e+07	2.33e+07	3.11e+07	3.89e+07	4.67e+07	6.22e+07	7.76e+07	9.18e+07
NEUT. FLUX	0.00e+00	2.18e+14	2.17e+14	2.17e+14	2.17e+14	2.19e+14	2.19e+14	2.24e+14	2.30e+14	2.36e+14	2.50e+14	2.63e+14
SP POW/MW	0.00e+00	2.59e+01	2.59e+01	2.59e+01	2.59e+01	2.59e+01	2.59e+01	2.59e+01	2.59e+01	2.59e+01	2.59e+01	2.59e+01
BURNUP/MWD	0.00e+00	7.77e+02	7.77e+02	7.77e+02	7.77e+02	7.77e+02	7.77e+02	7.77e+02	7.77e+02	7.77e+02	7.77e+02	7.77e+02
K INFINITY	0.	1.31517	1.30613	1.29990	1.26702	1.23517	1.20064	1.17467	1.14923	1.09166	1.04119	1.00626
NEUT PROD	0.00e+00	9.17e+03	9.25e+03	9.31e+03	9.38e+03	9.35e+03	9.25e+03	9.11e+03	8.96e+03	8.58e+03	8.20e+03	7.88e+03
NEUT DEST	0.00e+00	6.97e+03	7.08e+03	7.16e+03	7.40e+03	7.57e+03	7.70e+03	7.76e+03	7.80e+03	7.86e+03	7.86e+03	7.83e+03
TOT BURNUP	0.00e+00	2.75e+04	2.75e+04	2.75e+04	2.75e+04	2.75e+04	2.75e+04	2.75e+04	2.75e+04	2.75e+04	2.75e+04	2.75e+04
AVG N FLUX	0.00e+00	2.35e+14	2.35e+14	2.35e+14	2.35e+14	2.35e+14	2.35e+14	2.35e+14	2.35e+14	2.35e+14	2.35e+14	2.35e+14
AVG SP POW	0.00e+00	2.59e+01	2.59e+01	2.59e+01	2.59e+01	2.59e+01	2.59e+01	2.59e+01	2.59e+01	2.59e+01	2.59e+01	2.59e+01

SIZE OF MMAX(1): MMAX= 1 8= 568 MMAX= 2 8= 252 MMAX= 3 8= 72 MMAX= 4 8= 26 MMAX= 5 8= 20 MMAX= 6 8= 32
 MMAX= 7 8= 24 MMAX= 8 8= 0 MMAX= 9 8= 0 MMAX= 10 8= 0 MMAX= 11 8= 0 MMAX= 12 8= 0

THE NUMBER OF NON-ZERO TERMS IN A=4916
 THE NUMBER OF NON-ZERO FISSION PRODUCT YIELDS=3242
 ILITE= 0 IACT= 125 IFP= 879 ITOT=1008
 THE NUMBER OF MCN-ZERO NATURAL ABUNDANCES= 154
 THE NUMBER OF MCN-ZERO FICTCN YIELDS= 0
 THE MAXIMUM NUMBER OF TERPS IN AP= 2187

OUTPUT UNIT = 11

* IRRADIATION OF ONE METRIC TON OF BWR-U FUEL *

POWER= 2.59000e+01 MW, BURNUP= 2.75058e+04 MWD, FLUX= 2.35e+14 N/CM^2-SEC
 & SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS
 METRIC TON OF BWR-U FUEL

ACTINIDES+DAUGHTERS

	0. S	30.00	60.00	90.00	180.00	270.00	360.00	450.00	540.00	720.00	900.00	1062.00
U235	2.784e-02	2.694e-02	1.607e-02	2.523e-02	2.268e-02	2.075e-02	1.879e-02	1.697e-02	1.530e-02	1.231e-02	9.777e-03	7.846e-03
U236	0.000e+00	1.697e-04	3.327e-04	4.890e-04	9.225e-04	1.312e-03	1.658e-03	1.984e-03	2.273e-03	2.769e-03	3.163e-03	3.439e-03
U238	9.719e-01	9.722e-01	9.724e-01	9.727e-01	9.735e-01	9.742e-01	9.750e-01	9.757e-01	9.764e-01	9.776e-01	9.786e-01	9.794e-01
PU239	0.000e+00	4.152e-04	8.385e-04	1.219e-03	2.148e-03	2.836e-03	3.355e-03	3.754e-03	4.062e-03	4.475e-03	4.728e-03	4.880e-03
PU240	0.000e+00	8.226e-06	2.217e-05	6.791e-05	2.211e-04	4.078e-04	6.189e-04	8.334e-04	1.036e-03	1.452e-03	1.826e-03	2.132e-03
PU241	0.000e+00	3.282e-07	2.451e-06	7.676e-06	4.872e-05	1.308e-04	2.247e-04	3.326e-04	4.735e-04	7.136e-04	9.434e-04	1.118e-03
SUMTCT	9.997e-01	9.997e-01	9.997e-01	9.997e-01	9.997e-01	9.997e-01	9.996e-01	9.996e-01	9.995e-01	9.993e-01	9.991e-01	9.988e-01
TOTAL	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00

OUTPUT UNIT = 11

* IRRADIATION OF ONE METRIC TON OF BWR-U FUEL *

POWER= 2.59000e+01 MW, BURNUP= 2.75058e+04 MWD, FLUX= 2.35e+14 N/CM^2-SEC
 & SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS
 METRIC TON OF BWR-U FUEL

ACTINIDES+DAUGHTERS

	0. S	30.00	60.00	90.00	180.00	270.00	360.00	450.00	540.00	720.00	900.00	1062.00
U	1.000e+00	9.995e-01	9.991e-01	9.986e-01	9.975e-01	9.965e-01	9.956e-01	9.949e-01	9.941e-01	9.929e-01	9.918e-01	9.908e-01
PU	0.000e+00	4.238e-04	8.732e-04	1.295e-03	2.421e-03	3.386e-03	4.224e-03	4.975e-03	5.654e-03	6.821e-03	7.816e-03	8.6C5e-03
SUMTCT	1.000e+00	9.995e-01	9.995e-01	9.995e-01	9.995e-01	9.995e-01	9.995e-01	9.995e-01	9.995e-01	9.995e-01	9.995e-01	9.995e-01
TOTAL	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00

FISSION PRODUCTS

* IRRADIATION OF ONE METRIC TON OF BWR-U FUEL *

POWER= 2.59000e+01 PH, BURNUP= 2.75058e+04 MWD, FLUX= 2.35e+14 N/CM^2-SEC
 4 SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS
 METRIC TON OF BWR-U FUEL

	0.5	30.00	60.00	90.00	180.00	270.00	360.00	450.00	540.00	720.00	900.00	1062.00
BA 81	0.000e+00	1.664e-03	1.058e-03	1.053e-03	1.039e-03	1.027e-03	1.015e-03	1.003e-03	9.912e-04	9.686e-04	9.463e-04	9.265e-04
SE 82	0.000e+00	1.652e-03	1.639e-03	1.628e-03	1.599e-03	1.573e-03	1.550e-03	1.528e-03	1.510e-03	1.473e-03	1.440e-03	1.411e-03
CR 83	0.000e+00	2.622e-03	2.595e-03	2.563e-03	2.470e-03	2.383e-03	2.303e-03	2.226e-03	2.151e-03	2.010e-03	1.876e-03	1.760e-03
CR 84	0.000e+00	5.170e-03	5.035e-03	5.004e-03	4.927e-03	4.864e-03	4.814e-03	4.771e-03	4.733e-03	4.670e-03	4.618e-03	4.579e-03
CR 85	0.000e+00	1.200e-03	1.289e-03	1.275e-03	1.235e-03	1.198e-03	1.165e-03	1.136e-03	1.105e-03	1.051e-03	1.002e-03	9.602e-04
CR 86	0.000e+00	4.209e-03	4.800e-03	4.762e-03	4.653e-03	4.554e-03	4.469e-03	4.391e-03	4.318e-03	4.186e-03	4.065e-03	3.963e-03
CR 87	0.000e+00	9.147e-03	5.625e-03	9.522e-03	5.247e-03	9.008e-03	8.803e-03	8.610e-03	8.441e-03	8.126e-03	7.841e-03	7.603e-03
CR 88	0.000e+00	1.428e-02	1.228e-02	1.215e-02	1.180e-02	1.148e-02	1.122e-02	1.097e-02	1.074e-02	1.033e-02	9.957e-03	9.644e-03
SR 89	0.000e+00	1.635e-02	1.552e-02	1.528e-02	1.478e-02	1.434e-02	1.395e-02	1.360e-02	1.327e-02	1.278e-02	1.244e-02	1.214e-02
Y 89	0.000e+00	4.195e-03	7.325e-03	9.704e-03	1.397e-02	1.544e-02	1.687e-02	1.759e-02	1.745e-02	1.739e-02	1.708e-02	1.672e-02
SR 90	0.000e+00	2.755e-02	2.717e-02	2.683e-02	2.594e-02	2.516e-02	2.448e-02	2.386e-02	2.327e-02	2.220e-02	2.122e-02	2.040e-02
Y 91	0.000e+00	4.317e-02	1.981e-02	1.684e-02	1.089e-02	7.569e-03	5.607e-03	4.354e-03	3.503e-03	2.437e-03	1.820e-03	1.456e-03
ZR 92	0.000e+00	4.412e-03	7.933e-03	1.070e-02	1.595e-02	1.888e-02	2.009e-02	2.032e-02	2.119e-02	2.138e-02	2.120e-02	2.089e-02
ZR 93	0.000e+00	2.679e-02	2.868e-02	2.649e-02	2.789e-02	2.735e-02	2.685e-02	2.640e-02	2.598e-02	2.522e-02	2.452e-02	2.393e-02
ZR 94	0.000e+00	3.644e-02	3.027e-02	3.011e-02	2.972e-02	2.931e-02	2.898e-02	2.867e-02	2.854e-02	2.795e-02	2.728e-02	2.670e-02
ZR 95	0.000e+00	2.693e-02	2.307e-02	1.993e-02	1.350e-02	9.755e-03	7.450e-03	5.924e-03	4.898e-03	3.536e-03	2.769e-03	2.297e-03
MO 95	0.000e+00	3.600e-03	5.705e-03	6.519e-03	6.264e-03	5.071e-03	4.036e-03	3.269e-03	2.710e-03	1.584e-03	1.543e-03	1.278e-03
MO 96	0.000e+00	8.672e-04	2.606e-03	4.790e-03	1.110e-02	1.567e-02	1.867e-02	2.051e-02	2.188e-02	2.308e-02	2.391e-02	2.408e-02
MO 96	0.000e+00	3.102e-02	2.900e-02	3.079e-02	3.031e-02	3.011e-02	2.924e-02	2.924e-02	2.973e-02	2.940e-02	2.908e-02	2.881e-02
MO 96	0.000e+00	4.124e-06	8.942e-06	1.754e-05	6.462e-05	1.360e-04	2.213e-04	2.173e-04	4.211e-04	6.400e-04	8.759e-04	1.100e-03
MO 97	0.000e+00	2.614e-02	2.842e-02	2.875e-02	2.885e-02	2.882e-02	2.877e-02	2.871e-02	2.864e-02	2.849e-02	2.834e-02	2.821e-02
PC 98	0.000e+00	2.509e-02	2.908e-02	2.907e-02	2.907e-02	2.906e-02	2.905e-02	2.903e-02	2.901e-02	2.896e-02	2.890e-02	2.885e-02
PO 99	0.000e+00	3.561e-03	1.983e-03	1.320e-03	6.594e-04	4.382e-04	3.278e-04	2.433e-04	2.185e-04	1.622e-04	1.302e-04	1.172e-04
YC 99	0.000e+00	2.611e-02	2.767e-02	2.832e-02	2.887e-02	2.933e-02	2.887e-02	2.875e-02	2.859e-02	2.840e-02	2.783e-02	2.726e-02
MO100	0.000e+00	3.136e-02	3.140e-02	3.145e-02	3.160e-02	3.172e-02	3.182e-02	3.159e-02	3.197e-02	3.208e-02	3.217e-02	3.223e-02
RU100	0.000e+00	6.738e-05	1.452e-04	2.229e-04	4.550e-04	6.885e-04	9.201e-04	1.159e-03	1.405e-03	1.908e-03	2.439e-03	2.941e-03
RU102	0.000e+00	2.187e-02	2.575e-02	2.581e-02	2.597e-02	2.610e-02	2.619e-02	2.627e-02	2.634e-02	2.633e-02	2.649e-02	2.652e-02
RU103	0.000e+00	1.297e-02	1.037e-02	8.806e-03	5.712e-03	4.157e-03	3.327e-03	2.781e-03	2.409e-03	1.902e-03	1.601e-03	1.416e-03
RU103	0.000e+00	3.265e-03	6.334e-03	8.312e-03	1.185e-02	1.359e-02	1.453e-02	1.553e-02	1.533e-02	1.550e-02	1.530e-02	1.455e-02
RU104	0.000e+00	1.559e-02	1.098e-02	1.134e-02	1.231e-02	1.314e-02	1.385e-02	1.450e-02	1.511e-02	1.471e-02	1.421e-02	1.365e-02
PO104	0.000e+00	2.870e-05	1.023e-04	2.075e-04	6.345e-04	1.151e-03	1.705e-03	2.233e-03	2.908e-03	4.187e-03	5.482e-03	6.697e-03
PO105	0.000e+00	5.116e-03	6.099e-03	6.518e-03	7.517e-03	8.333e-03	9.015e-03	9.626e-03	1.019e-02	1.118e-02	1.205e-02	1.276e-02
RU106	0.000e+00	2.528e-03	1.198e-03	3.435e-03	3.992e-03	4.386e-03	4.642e-03	4.827e-03	4.966e-03	5.114e-03	5.171e-03	5.176e-03
PO107	0.000e+00	4.229e-04	5.560e-04	6.892e-04	1.120e-03	1.594e-03	2.093e-03	2.613e-03	3.149e-03	3.740e-03	4.414e-03	5.171e-03
AC109	0.000e+00	1.581e-03	1.860e-03	2.121e-03	2.816e-03	3.266e-03	3.953e-03	4.400e-03	4.901e-03	5.740e-03	6.509e-03	7.151e-03
PO108	0.000e+00	8.847e-04	1.033e-03	1.268e-03	1.768e-03	2.198e-03	2.573e-03	2.924e-03	3.255e-03	3.860e-03	4.414e-03	4.877e-03
AC109	0.000e+00	3.656e-04	4.405e-04	4.721e-04	1.063e-03	1.312e-03	1.518e-03	1.658e-03	1.860e-03	2.132e-03	2.351e-03	2.513e-03
PO110	0.000e+00	7.142e-04	8.355e-04	9.005e-04	6.114e-04	7.350e-04	8.435e-04	9.453e-04	1.043e-03	1.250e-03	1.396e-03	1.546e-03
Y1127	0.000e+00	2.577e-03	2.300e-03	2.339e-03	1.017e-03	1.000e-03	1.165e-03	1.219e-03	1.266e-03	1.342e-03	1.403e-03	1.446e-03
Y1128	0.000e+00	3.427e-03	3.596e-03	3.724e-03	2.441e-03	2.266e-03	2.595e-03	2.656e-03	2.712e-03	2.806e-03	2.887e-03	2.951e-03
Y1129	0.000e+00	7.895e-03	7.982e-03	8.064e-03	5.281e-03	4.711e-03	4.234e-03	3.966e-03	4.482e-03	4.416e-03	4.714e-03	4.782e-03
Y1131	0.000e+00	5.114e-03	2.838e-03	1.917e-03	9.877e-04	6.663e-04	5.034e-04	4.066e-04	3.420e-04	2.562e-04	2.076e-04	1.784e-04
Y1131	0.000e+00	9.099e-03	1.164e-02	1.255e-02	1.340e-02	1.455e-02	1.590e-02	1.733e-02	1.816e-02	1.929e-02	2.069e-02	2.234e-02
Y1132	0.000e+00	3.292e-03	2.711e-03	2.114e-03	5.810e-04	3.898e-04	2.934e-04	2.361e-04	1.316e-04	1.269e-04	1.214e-04	1.165e-04
Y1132	0.000e+00	1.841e-02	2.033e-02	2.112e-02	2.231e-02	2.306e-02	2.394e-02	2.459e-02	2.484e-02	2.570e-02	2.686e-02	2.774e-02
Y1133	0.000e+00	1.401e-03	7.009e-04	4.664e-04	2.329e-04	1.546e-04	1.154e-04	9.218e-05	7.675e-05	5.861e-05	4.522e-05	3.842e-05
Y1133	0.000e+00	7.517e-03	4.036e-03	2.703e-03	1.407e-03	9.345e-04	6.980e-04	5.517e-04	4.645e-04	3.428e-04	2.740e-04	2.238e-04
C1133	0.000e+00	2.399e-02	2.870e-02	3.027e-02	3.148e-02	3.173e-02	3.170e-02	3.155e-02	3.134e-02	3.026e-02	2.919e-02	2.958e-02

♦ IRRADIATION OF ONE METRIC TON OF BWR-U FUEL *

POWER= 2.59000e+01 MW, BURNUP= 2.75038e+04 MWD, FLUX= 2.35e+14 N/CM²-SEC

4 SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS

METRIC TON OF BWR-U FUEL

FISSION PRODUCTS

	0.	5	30.00	60.00	90.00	180.00	270.00	360.00	450.00	540.00	720.00	900.00	1062.00
XE134	0.000e+00	3.811e-02	3.811e-02	3.811e-02	3.811e-02	3.811e-02	3.808e-02	3.805e-02	3.802e-02	3.800e-02	3.796e-02	3.793e-02	3.791e-02
CS134	0.000e+00	6.620e-05	1.689e-04	2.735e-04	5.855e-04	8.668e-04	1.121e-03	1.364e-03	1.566e-03	1.734e-03	2.013e-03	2.394e-03	2.707e-03
CS135	0.000e+00	9.219e-03	5.328e-03	9.375e-03	9.573e-03	9.520e-03	9.500e-03	9.500e-03	9.500e-03	9.500e-03	9.500e-03	9.500e-03	9.500e-03
XE136	0.000e+00	5.488e-02	5.514e-02	5.525e-02	5.559e-02	5.584e-02	5.604e-02	5.624e-02	5.645e-02	5.665e-02	5.684e-02	5.723e-02	5.757e-02
CS137	0.000e+00	3.037e-02	3.037e-02	3.037e-02	3.037e-02	3.037e-02	3.037e-02	3.037e-02	3.037e-02	3.037e-02	3.037e-02	3.037e-02	3.037e-02
BA137	0.000e+00	3.147e-05	6.047e-05	8.951e-05	1.768e-04	2.641e-04	3.513e-04	4.383e-04	5.252e-04	6.120e-04	6.988e-04	7.856e-04	8.724e-04
BA138	0.000e+00	3.147e-02	3.339e-02	3.331e-02	3.311e-02	3.293e-02	3.273e-02	3.253e-02	3.233e-02	3.213e-02	3.193e-02	3.173e-02	3.153e-02
LA139	0.000e+00	3.181e-02	3.176e-02	3.170e-02	3.162e-02	3.154e-02	3.146e-02	3.138e-02	3.130e-02	3.122e-02	3.114e-02	3.106e-02	3.098e-02
BA140	0.000e+00	1.515e-02	9.036e-03	6.188e-03	3.081e-03	2.029e-03	1.507e-03	1.197e-03	9.107e-04	7.213e-04	5.319e-04	3.425e-04	1.531e-04
LA140	0.000e+00	1.585e-03	1.216e-03	8.368e-04	4.622e-04	2.681e-04	1.966e-04	1.388e-04	9.100e-05	6.116e-05	3.132e-05	1.148e-05	4.823e-06
CE140	0.000e+00	1.458e-02	2.179e-02	2.456e-02	2.808e-02	2.506e-02	2.922e-02	2.976e-02	2.976e-02	2.976e-02	2.976e-02	2.976e-02	2.976e-02
CE141	0.000e+00	2.134e-02	1.632e-02	1.283e-02	7.303e-03	4.914e-03	3.655e-03	2.912e-03	2.410e-03	2.040e-03	1.767e-03	1.578e-03	1.397e-03
PR141	0.000e+00	7.243e-03	1.261e-02	1.602e-02	2.148e-02	2.374e-02	2.466e-02	2.548e-02	2.585e-02	2.624e-02	2.662e-02	2.700e-02	2.738e-02
CE142	0.000e+00	2.607e-02	2.884e-02	2.878e-02	2.862e-02	2.846e-02	2.830e-02	2.814e-02	2.798e-02	2.782e-02	2.766e-02	2.750e-02	2.734e-02
CE143	0.000e+00	1.511e-03	9.472e-04	6.243e-04	3.951e-04	1.992e-04	1.467e-04	1.122e-04	8.550e-05	6.130e-05	3.709e-05	1.288e-05	4.800e-06
PR143	0.000e+00	1.380e-02	8.552e-03	5.894e-03	2.956e-03	1.930e-03	1.424e-03	1.122e-03	9.225e-04	7.630e-04	6.130e-04	5.245e-04	4.397e-04
MD143	0.000e+00	1.313e-02	1.912e-02	2.181e-02	2.410e-02	2.433e-02	2.405e-02	2.357e-02	2.298e-02	2.239e-02	2.180e-02	2.121e-02	2.062e-02
CE144	0.000e+00	2.534e-02	2.457e-02	2.358e-02	2.293e-02	1.868e-02	1.675e-02	1.508e-02	1.364e-02	1.239e-02	1.128e-02	1.026e-02	9.240e-03
MD144	0.000e+00	1.502e-02	2.181e-03	3.238e-03	6.168e-03	8.747e-03	1.026e-02	1.305e-02	1.786e-02	1.761e-02	1.712e-02	1.665e-02	1.618e-02
MD145	0.000e+00	1.502e-02	1.904e-02	1.896e-02	1.867e-02	1.839e-02	1.812e-02	1.786e-02	1.761e-02	1.736e-02	1.712e-02	1.687e-02	1.662e-02
MD146	0.000e+00	1.490e-02	1.491e-02	1.493e-02	1.498e-02	1.505e-02	1.512e-02	1.521e-02	1.530e-02	1.539e-02	1.548e-02	1.557e-02	1.566e-02
MD147	0.000e+00	5.114e-03	2.936e-03	1.987e-03	9.878e-04	6.521e-04	4.894e-04	3.864e-04	3.207e-04	2.742e-04	2.342e-04	1.981e-04	1.681e-04
PR147	0.000e+00	6.053e-03	7.883e-03	8.453e-03	8.383e-03	7.770e-03	7.116e-03	6.463e-03	5.895e-03	5.327e-03	4.759e-03	4.191e-03	3.623e-03
SM147	0.000e+00	5.051e-05	1.418e-04	2.413e-04	5.246e-04	7.657e-04	9.668e-04	1.132e-03	1.265e-03	1.468e-03	1.718e-03	2.011e-03	2.304e-03
MD148	0.000e+00	8.572e-03	8.580e-03	8.583e-03	8.590e-03	8.593e-03	8.594e-03	8.595e-03	8.597e-03	8.601e-03	8.605e-03	8.609e-03	8.613e-03
SM148	0.000e+00	4.571e-05	1.717e-04	3.258e-04	8.153e-04	1.259e-03	1.652e-03	2.009e-03	2.336e-03	2.624e-03	2.912e-03	3.199e-03	3.486e-03
SM149	0.000e+00	1.202e-03	6.320e-04	4.278e-04	2.454e-04	1.667e-04	1.274e-04	1.020e-04	8.463e-05	7.030e-05	5.963e-05	5.100e-05	4.300e-05
MD150	0.000e+00	3.434e-03	2.664e-03	3.492e-03	3.373e-03	3.642e-03	3.701e-03	3.757e-03	3.805e-03	3.853e-03	3.901e-03	3.949e-03	4.000e-03
SM150	0.000e+00	3.772e-03	4.884e-03	5.284e-03	5.480e-03	5.584e-03	5.624e-03	5.680e-03	5.704e-03	5.725e-03	5.746e-03	5.767e-03	5.788e-03
SM151	0.000e+00	1.755e-03	1.557e-03	1.371e-03	9.898e-04	7.711e-04	6.390e-04	5.478e-04	4.823e-04	4.337e-04	3.947e-04	3.611e-04	3.311e-04
SM152	0.000e+00	1.820e-03	2.126e-03	2.366e-03	2.621e-03	3.052e-03	3.164e-03	3.216e-03	3.232e-03	3.248e-03	3.264e-03	3.280e-03	3.296e-03
EU153	0.000e+00	8.423e-04	9.282e-04	9.917e-04	1.169e-03	1.340e-03	1.459e-03	1.648e-03	1.787e-03	1.940e-03	2.122e-03	2.304e-03	2.486e-03
EU154	0.000e+00	5.253e-05	9.403e-05	1.285e-04	2.159e-04	2.933e-04	3.633e-04	4.406e-04	5.200e-04	6.000e-04	6.800e-04	7.600e-04	8.400e-04
SUMTOT	0.000e+00	9.677e-01	5.899e-01	9.903e-01	9.915e-01	9.915e-01	9.915e-01	9.915e-01	9.915e-01	9.915e-01	9.915e-01	9.915e-01	9.915e-01
TOTAL	0.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00

OUTPUT UNIT = 11

* IRRADIATION OF ONE METRIC TON OF BWR-U FUEL *

POWER= 2.59000E+01 MW, BURNUP= 2.75058E+04 MWD, FLUX= 2.35E+14 N/CM^2-SEC
 SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS
 METRIC TON OF BWR-U FUEL

FISSION PRODUCTS

	0. S	30.00	60.00	90.00	180.00	270.00	360.00	450.00	540.00	720.00	900.00	1062.00
SE	0.000E+00	2.700E-03	2.604E-03	2.672E-03	2.638E-03	2.607E-03	2.579E-03	2.553E-03	2.528E-03	2.480E-03	2.435E-03	2.396E-03
BR	0.000E+00	1.003E-03	1.068E-03	1.059E-03	1.043E-03	1.029E-03	1.016E-03	1.004E-03	9.923E-04	9.694E-04	9.470E-04	9.270E-04
RR	0.000E+00	1.194E-02	1.865E-02	1.833E-02	1.792E-02	1.748E-02	1.711E-02	1.677E-02	1.646E-02	1.589E-02	1.531E-02	1.494E-02
NR	0.000E+00	1.728E-02	1.710E-02	1.692E-02	1.645E-02	1.604E-02	1.569E-02	1.537E-02	1.506E-02	1.452E-02	1.404E-02	1.361E-02
SR	0.000E+00	6.482E-02	6.050E-02	5.721E-02	5.074E-02	4.690E-02	4.388E-02	4.249E-02	4.096E-02	3.854E-02	3.659E-02	3.507E-02
Y	0.000E+00	2.464E-02	2.758E-02	2.684E-02	2.501E-02	2.368E-02	2.235E-02	2.170E-02	2.105E-02	1.986E-02	1.893E-02	1.820E-02
ZR	0.000E+00	1.536E-01	1.524E-01	1.513E-01	1.484E-01	1.457E-01	1.435E-01	1.414E-01	1.395E-01	1.362E-01	1.332E-01	1.307E-01
MB	0.000E+00	3.882E-03	5.750E-03	6.531E-03	6.282E-03	5.083E-03	4.035E-03	3.276E-03	2.716E-03	1.988E-03	1.546E-03	1.281E-03
MO	0.000E+00	9.339E-02	9.370E-02	9.540E-02	1.014E-01	1.059E-01	1.099E-01	1.108E-01	1.121E-01	1.136E-01	1.143E-01	1.146E-01
TC	0.000E+00	2.595E-02	2.784E-02	2.833E-02	2.893E-02	2.897E-02	2.890E-02	2.877E-02	2.861E-02	2.826E-02	2.784E-02	2.744E-02
RU	0.000E+00	7.417E-02	7.273E-02	7.187E-02	7.115E-02	7.169E-02	7.250E-02	7.346E-02	7.450E-02	7.647E-02	7.842E-02	8.013E-02
RH	0.000E+00	4.131E-03	6.595E-03	8.503E-03	1.197E-02	1.368E-02	1.460E-02	1.511E-02	1.539E-02	1.555E-02	1.536E-02	1.498E-02
PD	0.000E+00	8.824E-03	1.014E-02	1.129E-02	1.447E-02	1.745E-02	2.019E-02	2.265E-02	2.545E-02	3.043E-02	3.522E-02	3.961E-02
AG	0.000E+00	6.233E-04	7.112E-04	8.118E-04	1.097E-03	1.342E-03	1.565E-03	1.725E-03	1.888E-03	2.162E-03	2.386E-03	2.550E-03
CB	0.000E+00	1.636E-03	1.119E-03	1.182E-03	1.348E-03	1.506E-03	1.659E-03	1.819E-03	1.987E-03	2.338E-03	2.719E-03	3.088E-03
SN	0.000E+00	1.814E-03	1.811E-03	1.828E-03	1.894E-03	1.959E-03	2.016E-03	2.071E-03	2.125E-03	2.221E-03	2.310E-03	2.387E-03
TE	0.000E+00	1.430E-02	1.256E-02	1.202E-02	1.164E-02	1.166E-02	1.176E-02	1.188E-02	1.202E-02	1.227E-02	1.251E-02	1.272E-02
I	0.000E+00	1.134E-02	8.264E-03	7.202E-03	6.324E-03	6.152E-03	6.166E-03	6.153E-03	6.200E-03	6.755E-03	6.390E-03	6.464E-03
XE	0.000E+00	1.289E-01	1.295E-01	1.299E-01	1.309E-01	1.316E-01	1.321E-01	1.326E-01	1.331E-01	1.339E-01	1.347E-01	1.354E-01
CS	0.000E+00	6.372E-02	6.861E-02	7.034E-02	7.197E-02	7.255E-02	7.282E-02	7.291E-02	7.296E-02	7.274E-02	7.248E-02	7.230E-02
BA	0.000E+00	4.879E-02	4.259E-02	3.969E-02	3.652E-02	3.545E-02	3.496E-02	3.470E-02	3.457E-02	3.452E-02	3.468E-02	3.487E-02
LA	0.000E+00	3.414E-02	3.315E-02	3.264E-02	3.198E-02	3.168E-02	3.144E-02	3.125E-02	3.110E-02	3.082E-02	3.058E-02	3.039E-02
CE	0.000E+00	9.274E-02	5.247E-02	9.078E-02	8.244E-02	8.131E-02	7.840E-02	7.606E-02	7.412E-02	7.093E-02	6.855E-02	6.686E-02
PR	0.000E+00	2.160E-02	2.128E-02	2.204E-02	2.448E-02	2.570E-02	2.630E-02	2.662E-02	2.679E-02	2.652E-02	2.689E-02	2.679E-02
MD	0.000E+00	6.533E-02	7.026E-02	7.302E-02	7.714E-02	7.950E-02	8.124E-02	8.262E-02	8.374E-02	8.552E-02	8.675E-02	8.754E-02
PM	0.000E+00	6.648E-03	8.355E-03	8.825E-03	8.648E-03	7.987E-03	7.302E-03	6.648E-03	6.044E-03	5.007E-03	4.167E-03	3.544E-03
SN	0.000E+00	9.192E-03	1.003E-02	1.034E-02	1.034E-02	1.220E-02	1.282E-02	1.335E-02	1.380E-02	1.453E-02	1.502E-02	1.531E-02
EU	0.000E+00	1.132E-03	1.220E-03	1.295E-03	1.509E-03	1.738E-03	1.965E-03	2.193E-03	2.419E-03	2.839E-03	3.213E-03	3.499E-03
GO	0.000E+00	1.432E-04	2.039E-04	2.509E-04	3.127E-04	4.812E-04	5.831E-04	6.840E-04	7.948E-04	1.056E-03	1.368E-03	1.689E-03
SUMTOT	0.000E+00	9.988E-01	9.989E-01	9.989E-01	9.989E-01	9.989E-01	9.989E-01	9.989E-01	9.989E-01	9.989E-01	9.989E-01	9.989E-01
TOTAL	0.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

Command File and Output Data

```
-1  
-1  
-1  
BAS ONE METRIC TON CF CANDU FUEL  
LIP 0 0 0  
LIB 0 0 2 3 401 402 403 5 3 0 1 21  
PIC 0 0 0 10  
OPTL 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8  
OPTA 8 8 8 7 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 6 8  
OFTF 8 8 8 7 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8  
IAP -1 1 -1 -1 1 1  
MCV -1 1 0 1.0  
  
BLP  
IRP 30 25.57 1 2 4 2  
IRP 60 25.57 2 3 4 0  
IRP 90 25.57 3 4 4 0  
IRP 120 25.57 4 5 4 0  
IRP 150 25.57 5 6 4 0  
IRP 180 25.57 6 7 4 0  
IRP 210 25.57 7 8 4 0  
IRP 240 25.57 8 9 4 0  
IRP 270 25.57 9 10 4 0  
IRP 293.3 25.57 10 11 4 0  
  
BLP  
TIT * IRRADIATION OF ONE METRIC TON OF CANDU FUEL *  
OUT -11 1 -1 0  
END
```

	2	4	4	4	4	4	4	4	4	4	0	FUEL ACTINIDES
	922340	55.0	92235C	7115.0	922380	592830.0	0	0.0				
	C30000	1.0	O5000C	1.0	060000	89.4	C70000	25.0				FUEL IMPUR
	C80000	134454.0	C9000C	10.7	110000	15.0	120000	2.0				FUEL IMPUR
	130000	16.7	14000C	12.1	150000	35.0	170000	5.3				FUEL IMPUR
	200000	2.0	22000C	1.0	230000	3.0	240000	4.0				FUEL IMPUR
	250000	1.7	26000C	18.0	270000	1.0	280000	24.0				FUEL IMPUR
	290000	1.0	30000C	40.3	420000	10.0	470000	0.1				FUEL IMPUR
	480000	25.0	49000C	2.0	500000	4.0	640000	2.5				FUEL IMPUR
	740000	2.0	82000C	1.0	830000	0.4	C	0.0				FUEL IMPUR

OUTPUT UNIT = 11

* IRRADIATION OF ONE METRIC TON OF CANDU FUEL *
 POWER= 2.55700e+01 MW. BURNUP= 7.49568e+03 MW, FLUX= 2.35e+14 N/CM^2-SEC
 REACTIVITY AND BURNUP DATA
 BASIS= METRIC TON OF CANDU FUEL

	C. 5	30.0C	60.00	90.0C	120.00	150.0C	180.00	210.0C	240.00	270.0C	253.30
TIME, SEC	C.00e+0C	2.55e+06	5.18e+06	7.78e+06	1.04e+07	1.30e+07	1.56e+07	1.81e+07	2.07e+07	2.33e+07	2.53e+07
NEUT. FLUX	C.00e+0C	2.30e+14	2.30e+14	2.30e+14	2.31e+14	2.32e+14	2.35e+14	2.37e+14	2.40e+14	2.42e+14	2.44e+14
SP PC/MW	C.00e+0C	2.56e+01	2.56e+01	2.56e+01	2.56e+01	2.56e+01	2.56e+01	2.56e+01	2.56e+01	2.56e+01	2.56e+01
BURNUP,MWD	C.00e+0C	7.67e+02	7.67e+02	7.67e+02	7.67e+02	7.67e+02	7.67e+02	7.67e+02	7.67e+02	7.67e+02	7.67e+02
K INFINITY	0.	1.00224	1.01546	1.02111	1.01941	1.01367	1.00001	0.99563	0.98628	0.97550	0.96872
NEUT PRCON	C.00e+0C	7.74e+03	8.03e+03	8.21e+03	8.32e+03	8.37e+03	8.39e+03	8.39e+03	8.37e+03	8.35e+03	8.34e+03
NEUT DESTN	C.00e+0C	7.71e+03	7.91e+03	8.04e+03	8.16e+03	8.26e+03	8.34e+03	8.42e+03	8.49e+03	8.56e+03	8.61e+03
TOT BURNUP	C.00e+0C	7.50e+03	7.50e+03	7.50e+03	7.50e+03	7.50e+03	7.50e+03	7.50e+03	7.50e+03	7.50e+03	7.50e+03
AVG N FLUX	C.00e+0C	2.35e+14	2.35e+14	2.35e+14	2.35e+14	2.35e+14	2.35e+14	2.35e+14	2.35e+14	2.35e+14	2.35e+14
AVG SP PQW	C.00e+0C	2.56e+01	2.56e+01	2.56e+01	2.56e+01	2.56e+01	2.56e+01	2.56e+01	2.56e+01	2.56e+01	2.56e+01

SIZE OF MMAX(I): MMAX= 1 0= 568 MMAX= 2 0= 252 MMAX= 3 0= 68 MMAX= 4 0= 22 MMAX= 5 0= 26 MMAX= 6 0= 41
 PMAX= 7 0= 25 PMAX= 8 0= 0 PMAX= 9 0= 0 PMAX= 10 0= 0 PMAX= 11 0= 0 PMAX= 12 0= 0

THE NUMBER OF NON-ZERO TERMS IN A=4530
 THE NUMBER OF NON-ZERO FISSION PRODUCT YIELDS=3242
 ILITE= 0 IACT= 125 IFF= 879 ITOT=1008
 THE NUMBER OF NON-ZERO NATURAL ABUNDANCES= 154
 THE NUMBER OF NON-ZERO FICTON YIELDS= 0
 THE MAXIMUM NUMBER OF TERMS IN AP= 2211

OUTPUT UNIT = 11

* IRRADIATION OF ONE METRIC TON OF CANDU FUEL *

POWER= 2.55700e+01 MW, BURNUP= 7.49968e+03 MWD, FLUX= 2.35e+14 N/CM^2-SEC
 4 SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS
 METRIC TON CF CANDU FUEL

ACTINIDES+CAUGHTERS

	C. S	3C.0C	60.00	90.0C	120.00	150.0C	180.00	210.0C	240.00	270.0C	293.30
U235	7.205e-02	6.270e-03	5.646e-03	5.017e-03	4.462e-03	3.967e-03	3.526e-03	3.132e-03	2.778e-03	2.461e-03	2.235e-03
U238	9.927e-01	9.527e-01	9.280e-01	9.028e-01	8.780e-01	8.528e-01	8.276e-01	8.024e-01	7.772e-01	7.520e-01	7.268e-01
PU239	0.000e+00	5.225e-04	1.035e-03	1.489e-03	1.800e-03	2.051e-03	2.249e-03	2.406e-03	2.540e-03	2.648e-03	2.723e-03
PU240	0.000e+00	2.613e-05	5.577e-05	1.915e-04	3.034e-04	4.259e-04	5.542e-04	6.845e-04	8.160e-04	9.463e-04	1.043e-03
SUMT0Y	9.999e-01	9.597e-01	9.996e-01	9.995e-01	9.994e-01	9.993e-01	9.992e-01	9.991e-01	9.990e-01	9.989e-01	9.988e-01
TOTAL	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00

OUTPUT UNIT = 11

* IRRADIATION OF ONE METRIC TON OF CANDU FUEL *

POWER= 2.55700e+01 MW, BURNUP= 7.49968e+03 MWD, FLUX= 2.35e+14 N/CM^2-SEC
 4 SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS
 METRIC TON CF CANDU FUEL

ACTINIDES+CAUGHTERS

	O. S	3C.0D	60.00	90.00	120.00	150.0C	180.00	210.00	240.00	270.0C	293.30
U	1.000e+00	9.592e-01	9.987e-01	9.982e-01	9.978e-01	9.974e-01	9.970e-01	9.967e-01	9.964e-01	9.961e-01	9.958e-01
PU	0.000e+00	6.101e-04	1.198e-03	1.702e-03	2.145e-03	2.544e-03	2.904e-03	3.231e-03	3.538e-03	3.822e-03	4.032e-03
SUMTCT	1.000e+00	9.595e-01	9.999e-01	9.999e-01	9.999e-01	9.999e-01	9.999e-01	9.999e-01	9.999e-01	9.999e-01	9.999e-01
TOTAL	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00

FISSION PRODUCTS

IRRADIATION OF ONE METRIC TON OF CANDU FUEL *

POWER = 2.55700E+01 MW, BURNUP = 7.49968E+03 MWD, FLUX = 2.35E+14 N/CM^2-SEC

SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS

METRIC TON OF CANDU FUEL

	C. S	3C-00	6C-00	90-0C	120-0C	150-0C	180-00	210-00	240-00	270-0C	292-30
BR 81	0.000E+00	1.642E-03	1.028E-03	1.015E-03	1.004E-03	9.941E-04	9.845E-04	9.753E-04	9.666E-04	9.582E-04	9.518E-04
SE 82	0.000E+00	1.626E-03	1.584E-03	1.549E-03	1.520E-03	1.493E-03	1.470E-03	1.448E-03	1.427E-03	1.408E-03	1.395E-03
BR 83	0.000E+00	2.480E-03	2.335E-03	2.201E-03	2.080E-03	1.969E-03	1.865E-03	1.769E-03	1.679E-03	1.594E-03	1.522E-03
BR 84	0.000E+00	4.592E-03	4.903E-03	4.832E-03	4.738E-03	4.639E-03	4.537E-03	4.435E-03	4.330E-03	4.214E-03	4.098E-03
BR 85	0.000E+00	1.270E-03	1.226E-03	1.185E-03	1.145E-03	1.117E-03	1.088E-03	1.061E-03	1.036E-03	1.013E-03	9.916E-04
BR 86	0.000E+00	4.714E-03	4.556E-03	4.415E-03	4.292E-03	4.184E-03	4.085E-03	3.995E-03	3.913E-03	3.836E-03	3.761E-03
BR 87	0.000E+00	9.496E-03	9.058E-03	8.764E-03	8.481E-03	8.235E-03	8.012E-03	7.809E-03	7.625E-03	7.454E-03	7.311E-03
BR 88	0.000E+00	1.212E-02	1.161E-02	1.118E-02	1.081E-02	1.049E-02	1.020E-02	9.930E-03	9.686E-03	9.464E-03	9.262E-03
BR 89	0.000E+00	1.444E-02	1.452E-02	1.416E-02	1.412E-02	1.374E-02	1.344E-02	1.316E-02	1.290E-02	1.266E-02	1.244E-02
BR 90	0.000E+00	4.107E-03	7.013E-03	9.077E-03	1.058E-02	1.162E-02	1.235E-02	1.286E-02	1.319E-02	1.340E-02	1.350E-02
BR 91	0.000E+00	2.694E-02	2.572E-02	2.472E-02	2.386E-02	2.310E-02	2.242E-02	2.179E-02	2.122E-02	2.068E-02	2.020E-02
BR 92	0.000E+00	2.284E-02	1.873E-02	1.543E-02	1.284E-02	1.080E-02	9.175E-03	7.862E-03	6.802E-03	5.932E-03	5.359E-03
BR 93	0.000E+00	4.344E-03	7.646E-03	1.013E-02	1.198E-02	1.337E-02	1.440E-02	1.516E-02	1.572E-02	1.612E-02	1.635E-02
BR 94	0.000E+00	2.625E-02	2.478E-02	2.350E-02	2.240E-02	2.151E-02	2.080E-02	2.026E-02	1.978E-02	1.935E-02	1.896E-02
BR 95	0.000E+00	2.666E-02	2.256E-02	1.826E-02	1.660E-02	1.443E-02	1.265E-02	1.118E-02	9.956E-03	8.927E-03	8.230E-03
BR 96	0.000E+00	3.765E-03	5.603E-03	6.354E-03	6.490E-03	6.300E-03	5.950E-03	5.526E-03	5.110E-03	4.699E-03	4.301E-03
BR 97	0.000E+00	5.591E-03	5.510E-03	5.481E-03	5.425E-03	5.341E-03	5.228E-03	5.123E-03	5.026E-03	4.936E-03	4.852E-03
BR 98	0.000E+00	3.632E-02	2.044E-02	3.012E-02	2.985E-02	2.942E-02	2.940E-02	2.920E-02	2.901E-02	2.884E-02	2.872E-02
BR 99	0.000E+00	2.613E-02	2.852E-02	2.660E-02	2.855E-02	2.955E-02	2.850E-02	2.844E-02	2.835E-02	2.825E-02	2.815E-02
BR 100	0.000E+00	2.506E-02	2.907E-02	2.509E-02	2.910E-02	2.912E-02	2.912E-02	2.913E-02	2.914E-02	2.914E-02	2.915E-02
BR 101	0.000E+00	4.115E-03	2.004E-02	1.223E-03	5.867E-04	7.866E-04	6.541E-04	5.599E-04	4.695E-04	4.350E-04	4.016E-04
BR 102	0.000E+00	2.582E-02	2.784E-02	2.846E-02	2.865E-02	2.877E-02	2.878E-02	2.874E-02	2.868E-02	2.859E-02	2.853E-02
BR 103	0.000E+00	3.155E-02	3.175E-02	3.192E-02	3.207E-02	3.219E-02	3.230E-02	3.239E-02	3.248E-02	3.255E-02	3.260E-02
BR 104	0.000E+00	1.278E-04	2.758E-04	4.235E-04	5.713E-04	7.196E-04	8.694E-04	1.020E-03	1.172E-03	1.326E-03	1.445E-03
BR 105	0.000E+00	2.172E-02	2.599E-02	2.621E-02	2.635E-02	2.655E-02	2.669E-02	2.681E-02	2.692E-02	2.702E-02	2.709E-02
BR 106	0.000E+00	2.206E-02	2.265E-02	2.320E-02	2.365E-02	2.404E-02	2.440E-02	2.473E-02	2.503E-02	2.532E-02	2.552E-02
BR 107	0.000E+00	1.264E-02	1.178E-02	1.026E-02	5.017E-03	8.012E-03	7.200E-03	6.533E-03	5.974E-03	5.503E-03	5.177E-03
BR 108	0.000E+00	2.714E-03	6.573E-03	8.791E-03	1.045E-02	1.179E-02	1.278E-02	1.352E-02	1.407E-02	1.447E-02	1.470E-02
BR 109	0.000E+00	1.125E-02	1.265E-02	1.378E-02	1.475E-02	1.559E-02	1.636E-02	1.706E-02	1.770E-02	1.829E-02	1.871E-02
BR 110	0.000E+00	5.234E-05	2.988E-04	6.188E-04	1.014E-03	1.688E-03	1.967E-03	2.500E-03	3.059E-03	3.637E-03	4.098E-03
BR 111	0.000E+00	5.430E-03	6.195E-03	7.106E-03	7.858E-03	8.500E-03	9.068E-03	9.577E-03	1.003E-02	1.044E-02	1.074E-02
BR 112	0.000E+00	3.697E-03	4.817E-03	5.696E-03	6.397E-03	6.969E-03	7.452E-03	7.853E-03	8.206E-03	8.499E-03	8.689E-03
BR 113	0.000E+00	1.552E-03	2.420E-03	2.936E-03	3.431E-03	3.917E-03	4.404E-03	4.850E-03	5.375E-03	5.868E-03	6.326E-03
BR 114	0.000E+00	2.192E-03	2.178E-03	3.558E-03	4.700E-03	5.316E-03	5.876E-03	6.389E-03	6.855E-03	7.296E-03	7.611E-03
BR 115	0.000E+00	1.226E-03	2.023E-03	2.607E-03	3.110E-03	3.554E-03	3.960E-03	4.335E-03	4.680E-03	5.004E-03	5.288E-03
BR 116	0.000E+00	7.178E-04	1.212E-03	1.562E-03	1.850E-03	2.094E-03	2.306E-03	2.494E-03	2.657E-03	2.803E-03	2.920E-03
BR 117	0.000E+00	4.571E-04	6.505E-04	8.140E-04	9.551E-04	1.080E-03	1.195E-03	1.310E-03	1.400E-03	1.493E-03	1.560E-03
BR 118	0.000E+00	6.618E-04	6.654E-04	5.863E-04	1.081E-03	1.161E-03	1.230E-03	1.292E-03	1.346E-03	1.396E-03	1.431E-03
BR 119	0.000E+00	2.132E-03	2.347E-03	2.675E-03	2.581E-02	2.673E-03	2.754E-03	2.826E-03	2.890E-03	2.946E-03	2.989E-03
BR 120	0.000E+00	3.406E-03	2.721E-03	3.976E-03	4.173E-03	4.334E-03	4.469E-03	4.582E-03	4.676E-03	4.757E-03	4.810E-03
BR 121	0.000E+00	7.509E-03	8.232E-03	8.500E-03	8.725E-03	8.920E-03	9.092E-03	9.246E-03	9.384E-03	9.509E-03	9.596E-03
BR 122	0.000E+00	5.273E-03	2.941E-03	2.012E-03	1.533E-03	1.243E-03	1.069E-03	9.082E-04	8.014E-04	7.182E-04	6.620E-04
BR 123	0.000E+00	9.103E-03	1.157E-02	1.251E-02	1.294E-02	1.314E-02	1.321E-02	1.322E-02	1.317E-02	1.309E-02	1.301E-02
BR 124	0.000E+00	3.443E-03	1.762E-03	1.184E-03	6.948E-04	7.205E-04	6.046E-04	5.214E-04	4.586E-04	4.098E-04	3.783E-04
BR 125	0.000E+00	1.653E-02	2.075E-02	2.191E-02	2.270E-02	2.335E-02	2.392E-02	2.444E-02	2.492E-02	2.538E-02	2.572E-02
BR 126	0.000E+00	1.420E-03	7.094E-04	4.688E-04	2.698E-04	2.190E-04	1.987E-04	1.987E-04	1.737E-04	1.544E-04	1.425E-04
BR 127	0.000E+00	7.520E-03	4.064E-03	2.696E-03	1.616E-03	1.100E-03	1.341E-03	1.149E-03	1.005E-03	8.525E-04	8.152E-04
BR 128	0.000E+00	2.281E-02	2.800E-02	2.889E-02	2.952E-02	3.024E-02	3.094E-02	3.166E-02	3.232E-02	3.294E-02	3.350E-02
BR 129	0.000E+00	3.438E-02	3.841E-02	3.838E-02	3.834E-02	3.830E-02	3.827E-02	3.824E-02	3.821E-02	3.819E-02	3.817E-02

OUTPUT UNIT = 11

FISSION PRODUCTS

* IRRADIATION OF ONE METRIC TON OF CAROL FUEL *

PGMR= 2.55700e+01 PW, BURAU= 7.45560e+03 MW, FLUX= 2.35e+14 N/CM²-SEC4 SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS
METRIC TON OF CAROL FUEL

	0.	5	30.00	60.00	90.00	120.00	150.00	180.00	210.00	240.00	270.00	293.30
CS134	0.000e+00	1.282e-04	3.456e-04	5.514e-04	7.484e-04	9.359e-04	1.115e-03	1.285e-03	1.447e-03	1.601e-03	1.755e-03	
CS135	0.000e+00	1.721e-03	1.763e-03	1.797e-03	1.833e-03	1.872e-03	1.916e-03	1.965e-03	2.015e-03	2.070e-03	2.129e-03	
XE136	0.000e+00	6.297e-02	6.353e-02	6.391e-02	6.421e-02	6.447e-02	6.470e-02	6.491e-02	6.510e-02	6.527e-02	6.540e-02	
CS137	0.000e+00	3.053e-02	3.065e-02	3.074e-02	3.082e-02	3.088e-02	3.093e-02	3.098e-02	3.102e-02	3.105e-02	3.107e-02	
BA138	0.000e+00	3.240e-02	3.207e-02	3.280e-02	3.256e-02	3.236e-02	3.218e-02	3.201e-02	3.186e-02	3.173e-02	3.163e-02	
LA139	0.000e+00	3.171e-02	3.144e-02	3.118e-02	3.096e-02	3.075e-02	3.057e-02	3.039e-02	3.023e-02	3.008e-02	2.997e-02	
BA140	0.000e+00	1.515e-02	1.568e-03	6.078e-03	4.528e-03	3.589e-03	2.966e-03	2.524e-03	2.195e-03	1.941e-03	1.774e-03	
LA140	0.000e+00	1.596e-03	1.214e-03	8.288e-04	6.195e-04	4.931e-04	4.088e-04	3.451e-04	3.047e-04	2.704e-04	2.509e-04	
CE140	0.000e+00	1.495e-02	2.174e-02	2.486e-02	2.650e-02	2.747e-02	2.809e-02	2.852e-02	2.884e-02	2.907e-02	2.924e-02	
CE141	0.000e+00	2.117e-02	1.608e-02	1.255e-02	1.008e-02	8.111e-03	7.009e-03	6.026e-03	5.267e-03	4.668e-03	4.274e-03	
PR141	0.000e+00	7.466e-03	1.241e-02	1.575e-02	1.803e-02	1.963e-02	2.077e-02	2.159e-02	2.226e-02	2.265e-02	2.294e-02	
CE142	0.000e+00	2.697e-02	2.875e-02	2.861e-02	2.844e-02	2.828e-02	2.814e-02	2.800e-02	2.787e-02	2.775e-02	2.766e-02	
CE143	0.000e+00	1.696e-03	5.191e-04	5.931e-04	4.340e-04	3.405e-04	2.790e-04	2.357e-04	2.038e-04	1.791e-04	1.600e-04	
PR143	0.000e+00	1.564e-02	5.282e-03	5.596e-03	4.134e-03	3.249e-03	2.662e-03	2.248e-03	1.942e-03	1.707e-03	1.523e-03	
AC143	0.000e+00	1.260e-02	1.747e-02	1.896e-02	1.913e-02	1.875e-02	1.812e-02	1.728e-02	1.661e-02	1.620e-02	1.523e-02	
CE144	0.000e+00	2.135e-02	2.395e-02	2.270e-02	2.157e-02	2.053e-02	1.958e-02	1.869e-02	1.787e-02	1.710e-02	1.646e-02	
ND144	0.000e+00	1.713e-03	2.710e-03	5.705e-03	7.613e-03	9.613e-03	1.111e-02	1.270e-02	1.419e-02	1.559e-02	1.642e-02	
NC145	0.000e+00	1.622e-02	1.952e-02	1.819e-02	1.788e-02	1.760e-02	1.733e-02	1.707e-02	1.682e-02	1.659e-02	1.641e-02	
ND146	0.000e+00	1.431e-02	1.492e-02	1.494e-02	1.498e-02	1.503e-02	1.509e-02	1.516e-02	1.523e-02	1.531e-02	1.538e-02	
ND147	0.000e+00	5.052e-03	2.081e-03	1.933e-03	1.450e-03	1.143e-03	9.473e-04	8.082e-04	7.048e-04	6.247e-04	5.720e-04	
PM147	0.000e+00	5.624e-03	7.424e-03	7.759e-03	7.670e-03	7.423e-03	7.111e-03	6.778e-03	6.443e-03	6.115e-03	5.888e-03	
AC148	0.000e+00	8.576e-03	6.597e-03	6.606e-03	6.610e-03	6.613e-03	6.616e-03	6.618e-03	6.620e-03	6.622e-03	6.623e-03	
SM148	0.000e+00	9.241e-03	2.303e-04	6.069e-04	8.836e-04	1.149e-03	1.401e-03	1.639e-03	1.862e-03	2.072e-03	2.278e-03	
ND150	0.000e+00	3.467e-03	2.377e-03	3.670e-03	3.750e-03	3.820e-03	3.884e-03	3.943e-03	3.997e-03	4.047e-03	4.083e-03	
SM150	0.000e+00	4.756e-03	5.197e-03	5.375e-03	5.477e-03	5.542e-03	5.585e-03	5.612e-03	5.627e-03	5.632e-03	5.634e-03	
SM152	0.000e+00	3.112e-03	2.560e-03	3.766e-03	2.887e-03	3.363e-03	4.012e-03	4.042e-03	4.056e-03	4.059e-03	4.059e-03	
EU153	0.000e+00	9.044e-04	1.100e-03	1.257e-03	1.392e-03	1.511e-03	1.616e-03	1.710e-03	1.793e-03	1.865e-03	1.916e-03	
GD156	0.000e+00	8.468e-05	1.848e-04	2.847e-04	2.850e-04	4.890e-04	5.998e-04	7.190e-04	8.473e-04	9.849e-04	1.098e-03	
SUMICT	0.000e+00	9.622e-01	5.891e-01	9.856e-01	9.895e-01	9.932e-01	9.988e-01	9.988e-01	9.988e-01	9.988e-01	9.988e-01	
TOTAL	0.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	

OUTPUT UNIT = 11

FISSION PRODUCTS

* IRRADIATION OF ONE METRIC TON OF CANDU FUEL *

POWER= 2.55700E+01 MW, BURNUP= 7.49968E+03 MWD, FLUX= 2.35E+14 N/CM^2-SEC

4 SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS
METRIC TON OF CANDU FUEL

	0. S	30.00	60.00	90.00	120.00	150.00	180.00	210.00	240.00	270.00	293.30
SE	0.000E+00	2.435E-03	2.593E-03	2.555E-03	2.521E-03	2.491E-03	2.463E-03	2.438E-03	2.413E-03	2.391E-03	2.374E-03
BR	0.000E+00	1.037E-03	1.037E-03	1.021E-03	1.008E-03	9.973E-04	9.871E-04	9.776E-04	9.685E-04	9.599E-04	9.533E-04
KR	0.000E+00	1.642E-02	1.765E-02	1.705E-02	1.654E-02	1.609E-02	1.570E-02	1.534E-02	1.501E-02	1.471E-02	1.449E-02
RB	0.000E+00	1.68E-02	1.618E-02	1.560E-02	1.511E-02	1.468E-02	1.429E-02	1.393E-02	1.360E-02	1.330E-02	1.309E-02
SR	0.000E+00	5.15E-02	5.701E-02	5.236E-02	4.873E-02	4.581E-02	4.340E-02	4.136E-02	3.963E-02	3.812E-02	3.708E-02
Y	0.000E+00	2.782E-02	2.616E-02	2.480E-02	2.362E-02	2.258E-02	2.165E-02	2.082E-02	2.008E-02	1.941E-02	1.893E-02
ZR	0.000E+00	1.518E-01	1.483E-01	1.452E-01	1.424E-01	1.399E-01	1.376E-01	1.355E-01	1.335E-01	1.317E-01	1.304E-01
NR	0.000E+00	3.66E-03	5.648E-03	6.285E-03	6.514E-03	6.320E-03	5.967E-03	5.550E-03	5.122E-03	4.711E-03	4.413E-03
PD	0.000E+00	9.235E-02	5.395E-02	9.566E-02	5.764E-02	9.958E-02	1.014E-01	1.030E-01	1.043E-01	1.055E-01	1.063E-01
TC	0.000E+00	2.617E-02	2.803E-02	2.858E-02	2.878E-02	2.884E-02	2.893E-02	2.879E-02	2.872E-02	2.863E-02	2.856E-02
RU	0.000E+00	7.63E-02	7.825E-02	7.940E-02	8.080E-02	8.191E-02	8.299E-02	8.404E-02	8.504E-02	8.598E-02	8.685E-02
RM	0.000E+00	4.186E-03	6.878E-03	9.028E-03	1.069E-02	1.196E-02	1.293E-02	1.366E-02	1.420E-02	1.459E-02	1.481E-02
PO	0.000E+00	1.05E-02	1.480E-02	1.811E-02	2.109E-02	2.386E-02	2.649E-02	2.901E-02	3.142E-02	3.375E-02	3.550E-02
AG	0.000E+00	8.582E-04	1.304E-03	1.639E-03	1.915E-03	2.158E-03	2.367E-03	2.552E-03	2.715E-03	2.859E-03	2.958E-03
CC	0.000E+00	9.22E-04	1.138E-03	1.221E-03	1.492E-03	1.657E-03	1.839E-03	1.960E-03	2.141E-03	2.301E-03	2.426E-03
SA	0.000E+00	1.50E-03	1.636E-03	1.711E-03	1.775E-03	1.841E-03	1.898E-03	1.952E-03	2.006E-03	2.066E-03	2.075E-03
TE	0.000E+00	1.137E-02	1.294E-02	1.268E-02	1.267E-02	1.274E-02	1.285E-02	1.297E-02	1.309E-02	1.321E-02	1.330E-02
I	0.000E+00	1.37E-01	8.540E-03	7.640E-03	7.285E-03	7.135E-03	7.078E-03	7.045E-03	7.072E-03	7.092E-03	7.107E-03
NE	0.000E+00	1.271E-01	1.385E-01	1.396E-01	1.404E-01	1.411E-01	1.417E-01	1.422E-01	1.427E-01	1.431E-01	1.435E-01
CS	0.000E+00	5.625E-02	6.122E-02	6.203E-02	6.297E-02	6.455E-02	6.495E-02	6.523E-02	6.546E-02	6.560E-02	6.571E-02
BA	0.000E+00	4.672E-02	4.223E-02	3.911E-02	3.739E-02	3.631E-02	3.558E-02	3.504E-02	3.468E-02	3.432E-02	3.412E-02
LA	0.000E+00	3.404E-02	3.281E-02	3.212E-02	3.166E-02	3.131E-02	3.103E-02	3.079E-02	3.058E-02	3.039E-02	3.025E-02
CE	0.000E+00	9.238E-02	5.148E-02	8.932E-02	8.702E-02	8.494E-02	8.309E-02	8.147E-02	8.005E-02	7.877E-02	7.787E-02
PR	0.000E+00	2.136E-02	2.081E-02	2.142E-02	2.223E-02	2.293E-02	2.347E-02	2.388E-02	2.418E-02	2.439E-02	2.451E-02
AD	0.000E+00	6.518E-02	6.972E-02	7.210E-02	7.355E-02	7.456E-02	7.534E-02	7.598E-02	7.651E-02	7.703E-02	7.739E-02
PM	0.000E+00	6.61E-03	7.948E-03	8.180E-03	8.035E-03	7.749E-03	7.409E-03	7.053E-03	6.698E-03	6.344E-03	6.096E-03
SM	0.000E+00	9.412E-03	1.032E-02	1.099E-02	1.156E-02	1.204E-02	1.247E-02	1.284E-02	1.317E-02	1.345E-02	1.365E-02
EU	0.000E+00	1.423E-03	1.498E-03	1.717E-03	1.917E-03	2.104E-03	2.277E-03	2.437E-03	2.582E-03	2.714E-03	2.807E-03
GC	0.000E+00	2.09E-04	3.622E-04	5.088E-04	6.517E-04	7.960E-04	9.464E-04	1.105E-03	1.275E-03	1.451E-03	1.596E-03
SUMICT	0.000E+00	9.590E-01	5.990E-01	9.590E-01	5.965E-01	9.589E-01	9.989E-01	9.989E-01	9.989E-01	9.989E-01	9.989E-01
TOTAL	0.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

Command File and Output Data

61

OUTPUT UNIT = 11

* IRRADIATION OF ONE METRIC TON OF CANDU (1.28) FUEL *
 POWER= 2.55700E+01 MW, BURNUP= 2.09C09E+04 MWC, FLUX= 2.14E+14 N/CM**2-SEC
 REACTIVITY AND BURNUP DATA
 BASIS= METRIC TON OF CANDU (1.28) FUEL

	C. 5	30.0C	90.00	160.0C	270.0C	340.0C	450.00	540.00	630.00	720.0C	817.40
TIME, SEC	C.0C+0C	2.55E+04	7.78E+04	1.56E+05	2.33E+07	3.11E+07	3.89E+07	4.67E+07	5.44E+07	6.22E+07	7.06E+07
NEUT. FLUX	C.00E+00	1.73E+14	1.76E+14	1.83E+14	1.93E+14	2.03E+14	2.14E+14	2.26E+14	2.36E+14	2.44E+14	2.52E+14
SP PCM/MW	C.0C+0C	2.56E+01	2.56E+01	2.56E+01	2.56E+01	2.56E+01	2.56E+01	2.56E+01	2.56E+01	2.56E+01	2.56E+01
ELCALP/MW	C.00E+00	7.07E+02	1.55E+03	2.30E+03	2.30E+03	2.30E+03	2.30E+03	2.30E+03	2.30E+03	2.30E+03	2.30E+03
R INFINITY	0.	1.19052	1.16590	1.11823	1.06146	1.00260	0.94686	0.89909	0.85826	0.82684	0.80115
NEUT PROD	C.00E+00	1.04E+04	1.04E+04	1.01E+04	9.65E+03	9.16E+03	8.69E+03	8.30E+03	7.96E+03	7.64E+03	7.38E+03
NEUT DEST	C.0C+0C	8.72E+03	8.91E+03	9.03E+03	9.09E+03	9.14E+03	9.18E+03	9.23E+03	9.30E+03	9.37E+03	9.46E+03
TOT BURNUP	C.00E+00	2.09E+04	2.09E+04	2.09E+04	2.09E+04	2.09E+04	2.09E+04	2.09E+04	2.09E+04	2.09E+04	2.09E+04
AVG N FLUX	C.00E+00	2.14E+14	2.14E+14	2.14E+14	2.14E+14	2.14E+14	2.14E+14	2.14E+14	2.14E+14	2.14E+14	2.14E+14
AVG SP POW	C.00E+00	2.56E+01	2.56E+01	2.56E+01	2.56E+01	2.56E+01	2.56E+01	2.56E+01	2.56E+01	2.56E+01	2.56E+01

SIZE OF MMAX(1): MMAX= 1 N= 568 MMAX= 2 N= 252 MMAX= 3 N= 68 MMAX= 4 N= 22 MMAX= 5 N= 26 MMAX= 6 N= 41
 PMAX= 7 N= 25 PMAX= 8 N= 0 PMAX= 9 N= 0 MMAX= 10 N= 0 MMAX= 11 N= 0 MMAX= 12 N= 0

THE NUMBER OF NON-ZERO TERMS IN A=4930
 THE NUMBER OF NON-ZERO FISSION PRODUCT YIELDS=3242
 ILITE= 0 IACT= 125 IFP= 879 ITGT=1008
 THE NUMBER OF NON-ZERO NATURAL ABUNDANCES= 154
 THE NUMBER OF NON-ZERO FNUCTON YIELDS= 0
 THE MAXIMUM NUMBER OF TERMS IN AP= 2185

OUTPUT UNIT = 11

ACTINIDES+DAUGHTERS

* IRRADIATION OF ONE METRIC TON OF CANDU (1.2%) FUEL *
 POWER= 2.55700e+01 MW, BURNUP= 2.09009e+04 MWD, FLUX= 2.14e+14 N/CM^2-SEC
 4 SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS
 METRIC TON OF CANDU (1.2%) FUEL

	0.5	30.00	90.00	180.00	270.00	360.00	450.00	540.00	630.00	720.00	817.40
U235	1.215e-02	1.127e-02	9.665e-03	7.623e-03	5.933e-03	4.531e-03	3.391e-03	2.491e-03	1.795e-03	1.270e-03	8.623e-04
U236	0.000e+00	1.282e-04	3.879e-04	7.041e-04	5.627e-04	1.174e-03	1.341e-03	1.470e-03	1.565e-03	1.632e-03	1.678e-03
U238	9.877e-01	9.880e-01	9.885e-01	9.892e-01	9.898e-01	9.902e-01	9.904e-01	9.908e-01	9.909e-01	9.908e-01	9.907e-01
PU239	0.000e+00	4.182e-04	1.172e-03	1.933e-03	2.397e-03	2.691e-03	2.864e-03	2.953e-03	3.003e-03	3.047e-03	3.067e-03
PU240	0.000e+00	1.218e-05	1.007e-04	3.236e-04	6.238e-04	9.428e-04	1.268e-03	1.568e-03	1.836e-03	2.086e-03	2.311e-03
SUMTOT	5.999e-01	9.598e-01	5.998e-01	9.998e-01	9.997e-01	9.996e-01	9.994e-01	9.993e-01	9.991e-01	9.989e-01	9.987e-01
TOTAL	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00

OUTPUT UNIT = 11

ACTINIDES+DAUGHTERS

* IRRADIATION OF ONE METRIC TON OF CANDU (1.2%) FUEL *
 POWER= 2.55700e+01 MW, BURNUP= 2.09009e+04 MWD, FLUX= 2.14e+14 N/CM^2-SEC
 4 SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS
 METRIC TON OF CANDU (1.2%) FUEL

	0.5	30.00	90.00	180.00	270.00	360.00	450.00	540.00	630.00	720.00	817.40
U	1.000e+00	9.595e-01	9.987e-01	9.976e-01	9.968e-01	9.960e-01	9.954e-01	9.948e-01	9.943e-01	9.938e-01	9.933e-01
PU	0.000e+00	4.307e-04	1.280e-03	2.314e-03	3.152e-03	3.868e-03	4.491e-03	5.034e-03	5.517e-03	5.966e-03	6.397e-03
SUMTOT	1.000e+00	9.599e-01	9.999e-01	9.999e-01	9.999e-01	9.999e-01	9.999e-01	9.998e-01	9.998e-01	9.998e-01	9.997e-01
TOTAL	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00

OUTPUT UNIT = 11

FISSION PRODUCTS

* IRRADIATION OF ONE METRIC TON OF CANDU (1.2%) FUEL *

POWER= 2.55700e+01 MW, BURNUP= 2.09009e+04 MW0, FLUX= 2.14e+14 N/CM2-SEC

4 SUPPLY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS

METRIC TON OF CANDU (1.2%) FUEL

	0. S	30.00	90.00	180.00	270.00	360.00	450.00	540.00	630.00	720.00	810.00
C3133	0.000e+00	2.297e-02	2.983e-02	3.103e-02	3.105e-02	3.075e-02	3.031e-02	2.978e-02	2.920e-02	2.860e-02	2.792e-02
C3134	0.000e+00	3.642e-02	3.848e-02	3.842e-02	3.836e-02	3.831e-02	3.827e-02	3.823e-02	3.821e-02	3.819e-02	3.817e-02
C3135	0.000e+00	1.663e-04	4.593e-04	9.305e-04	1.357e-03	1.739e-03	2.080e-03	2.383e-03	2.641e-03	2.856e-03	3.041e-03
C3136	0.000e+00	2.228e-03	2.359e-03	2.406e-03	2.486e-03	2.611e-03	2.782e-03	3.001e-03	3.265e-03	3.568e-03	3.932e-03
C3137	0.000e+00	6.120e-02	6.285e-02	6.341e-02	6.387e-02	6.427e-02	6.464e-02	6.499e-02	6.531e-02	6.561e-02	6.590e-02
C3138	0.000e+00	3.150e-02	1.058e-02	3.087e-02	2.073e-02	3.077e-02	3.080e-02	3.061e-02	3.081e-02	3.082e-02	3.081e-02
C3139	0.000e+00	3.269e-02	2.340e-02	3.300e-02	2.267e-02	3.238e-02	3.213e-02	3.189e-02	3.168e-02	3.149e-02	3.131e-02
C3140	0.000e+00	3.189e-02	2.164e-02	3.123e-02	2.086e-02	3.052e-02	3.020e-02	2.988e-02	2.958e-02	2.929e-02	2.899e-02
C3141	0.000e+00	1.518e-02	6.148e-03	3.001e-03	1.961e-03	1.448e-03	1.155e-03	9.467e-04	8.068e-04	7.029e-04	6.168e-04
C3142	0.000e+00	1.597e-02	6.164e-04	4.020e-04	2.639e-04	1.988e-04	1.573e-04	1.315e-04	1.133e-04	9.984e-05	8.865e-05
C3143	0.000e+00	1.510e-02	2.492e-02	2.812e-02	2.911e-02	2.958e-02	2.985e-02	3.003e-02	3.016e-02	3.027e-02	3.038e-02
C3144	0.000e+00	2.128e-02	1.271e-02	7.132e-03	4.760e-03	3.528e-03	2.788e-03	2.299e-03	1.952e-03	1.696e-03	1.483e-03
C3145	0.000e+00	7.548e-03	1.598e-02	2.121e-02	2.323e-02	2.412e-02	2.458e-02	2.465e-02	2.465e-02	2.458e-02	2.440e-02
C3146	0.000e+00	2.519e-02	2.906e-02	2.879e-02	2.951e-02	2.825e-02	2.800e-02	2.777e-02	2.755e-02	2.734e-02	2.713e-02
C3147	0.000e+00	9.692e-06	6.500e-05	1.942e-04	3.488e-04	5.168e-04	6.951e-04	8.825e-04	1.075e-03	1.270e-03	1.481e-03
C3148	0.000e+00	1.505e-03	6.125e-04	2.905e-04	1.846e-04	1.359e-04	1.061e-04	8.672e-05	7.323e-05	6.335e-05	5.529e-05
C3149	0.000e+00	1.581e-02	5.838e-03	2.827e-03	1.817e-03	1.223e-03	1.032e-03	8.813e-04	7.085e-04	6.113e-04	5.244e-04
C3150	0.000e+00	1.594e-02	2.006e-02	2.010e-02	1.822e-02	1.612e-02	1.411e-02	1.226e-02	1.065e-02	9.279e-03	8.037e-03
C3151	0.000e+00	2.574e-02	2.349e-02	2.060e-02	1.817e-02	1.612e-02	1.436e-02	1.285e-02	1.154e-02	1.042e-02	9.362e-03
C3152	0.000e+00	1.530e-03	5.072e-03	1.010e-02	1.451e-02	1.832e-02	2.159e-02	2.440e-02	2.674e-02	2.859e-02	3.041e-02
C3153	0.000e+00	1.504e-02	1.872e-02	1.811e-02	1.752e-02	1.636e-02	1.624e-02	1.589e-02	1.538e-02	1.450e-02	1.440e-02
C3154	0.000e+00	1.497e-02	1.506e-02	1.524e-02	1.544e-02	1.568e-02	1.594e-02	1.621e-02	1.650e-02	1.680e-02	1.712e-02
C3155	0.000e+00	5.179e-03	1.958e-03	9.556e-04	6.275e-04	4.659e-04	3.704e-04	3.081e-04	2.641e-04	2.314e-04	2.044e-04
C3156	0.000e+00	5.183e-03	8.075e-03	7.598e-03	6.648e-03	5.733e-03	4.922e-03	4.223e-03	3.641e-03	3.133e-03	2.744e-03
C3157	0.000e+00	8.547e-03	8.575e-03	8.580e-03	8.583e-03	8.586e-03	8.589e-03	8.592e-03	8.595e-03	8.597e-03	8.598e-03
C3158	0.000e+00	3.275e-03	5.405e-04	1.266e-03	1.904e-03	2.453e-03	2.923e-03	3.326e-03	3.663e-03	3.946e-03	4.199e-03
C3159	0.000e+00	3.275e-03	3.482e-03	3.617e-03	3.736e-03	3.842e-03	3.940e-03	4.033e-03	4.120e-03	4.200e-03	4.279e-03
C3160	0.000e+00	4.609e-03	5.224e-03	5.333e-03	5.425e-03	5.400e-03	5.380e-03	5.247e-03	5.134e-03	5.028e-03	4.846e-03
C3161	0.000e+00	2.437e-03	2.417e-03	3.626e-03	3.888e-03	3.683e-03	3.641e-03	3.573e-03	3.487e-03	3.395e-03	3.273e-03
C3162	0.000e+00	8.402e-04	1.090e-03	1.380e-03	1.604e-03	1.774e-03	1.900e-03	1.987e-03	2.038e-03	2.055e-03	2.055e-03
C3163	0.000e+00	4.409e-04	5.070e-04	5.913e-04	6.657e-04	7.330e-04	7.943e-04	8.568e-04	9.140e-04	9.672e-04	1.020e-03
C3164	0.000e+00	4.739e-05	2.030e-04	4.099e-04	6.450e-04	9.550e-04	1.333e-03	1.775e-03	2.267e-03	2.793e-03	3.385e-03
C3165	0.000e+00	9.474e-01	5.915e-01	9.916e-01	9.910e-01	9.920e-01	9.925e-01	9.928e-01	9.929e-01	9.929e-01	9.929e-01
TOTAL	0.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00

OUTPUT UNIT = 11

FISSION PRODUCTS

* IRRADIATION OF ONE METRIC TON OF CANDU (1.25) FUEL *

POWER= 2.55700e+01 MW. BURNUP= 2.09009e+04 MWD. FLUX= 2.14e+14 N/CM2-SEC
 & SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS
 METRIC TON OF CANDU (1.25) FUEL

	0. S	3C.00	96.00	180.00	270.00	360.00	450.00	540.00	630.00	720.00	817.40
SE	0.000e+00	2.666e-03	2.623e-03	2.568e-03	2.510e-03	2.471e-03	2.426e-03	2.382e-03	2.339e-03	2.299e-03	2.258e-03
BR	0.000e+00	1.668e-03	1.641e-03	1.618e-03	1.597e-03	1.578e-03	1.561e-03	1.545e-03	1.530e-03	1.516e-03	1.502e-03
KR	0.000e+00	1.631e-02	1.615e-02	1.600e-02	1.585e-02	1.571e-02	1.557e-02	1.543e-02	1.530e-02	1.517e-02	1.504e-02
RB	0.000e+00	1.735e-02	1.672e-02	1.590e-02	1.510e-02	1.435e-02	1.367e-02	1.303e-02	1.243e-02	1.187e-02	1.135e-02
SR	0.000e+00	6.111e-02	5.644e-02	4.878e-02	4.405e-02	3.817e-02	3.600e-02	3.413e-02	3.250e-02	3.095e-02	2.940e-02
Y	0.000e+00	2.257e-02	2.653e-02	2.414e-02	2.228e-02	2.031e-02	1.855e-02	1.700e-02	1.565e-02	1.440e-02	1.325e-02
ZR	0.000e+00	1.542e-01	1.507e-01	1.459e-01	1.416e-01	1.378e-01	1.343e-01	1.311e-01	1.281e-01	1.253e-01	1.226e-01
NR	0.000e+00	3.499e-03	3.546e-03	3.621e-03	3.668e-03	3.698e-03	3.713e-03	3.725e-03	3.735e-03	3.744e-03	3.752e-03
PO	0.000e+00	9.255e-02	9.569e-02	1.016e-01	1.061e-01	1.099e-01	1.130e-01	1.155e-01	1.176e-01	1.193e-01	1.207e-01
TC	0.000e+00	2.613e-02	2.857e-02	2.992e-02	2.880e-02	2.855e-02	2.823e-02	2.786e-02	2.747e-02	2.706e-02	2.660e-02
RU	0.000e+00	7.148e-02	7.298e-02	7.166e-02	7.618e-02	7.836e-02	8.058e-02	8.277e-02	8.484e-02	8.676e-02	8.848e-02
RM	0.000e+00	4.615e-03	4.406e-03	1.179e-02	1.327e-02	1.384e-02	1.435e-02	1.479e-02	1.525e-02	1.572e-02	1.620e-02
PD	0.000e+00	8.745e-03	1.276e-02	1.812e-02	2.332e-02	2.837e-02	3.331e-02	3.817e-02	4.289e-02	4.739e-02	5.160e-02
AG	0.000e+00	5.761e-04	5.497e-04	1.425e-03	1.813e-03	2.131e-03	2.398e-03	2.626e-03	2.814e-03	2.965e-03	3.088e-03
CD	0.000e+00	7.580e-04	9.714e-04	1.267e-03	1.571e-03	1.822e-03	2.237e-03	2.603e-03	3.003e-03	3.410e-03	3.818e-03
SN	0.000e+00	1.270e-03	1.441e-03	1.569e-03	1.688e-03	1.794e-03	1.892e-03	1.983e-03	2.066e-03	2.140e-03	2.214e-03
TE	0.000e+00	1.282e-02	1.181e-02	1.168e-02	1.192e-02	1.220e-02	1.248e-02	1.275e-02	1.300e-02	1.323e-02	1.345e-02
IE	0.000e+00	1.695e-02	7.010e-03	6.254e-03	6.188e-03	6.241e-03	6.321e-03	6.395e-03	6.461e-03	6.504e-03	6.531e-03
RE	0.000e+00	1.261e-01	1.378e-01	1.394e-01	1.406e-01	1.417e-01	1.426e-01	1.433e-01	1.438e-01	1.443e-01	1.448e-01
CS	0.000e+00	5.498e-02	6.327e-02	6.506e-02	6.564e-02	6.599e-02	6.599e-02	6.600e-02	6.595e-02	6.588e-02	6.579e-02
EA	0.000e+00	4.504e-02	3.975e-02	3.637e-02	3.518e-02	3.400e-02	3.427e-02	3.408e-02	3.399e-02	3.396e-02	3.400e-02
LA	0.000e+00	3.422e-02	3.256e-02	3.168e-02	3.116e-02	3.074e-02	3.037e-02	3.003e-02	2.971e-02	2.940e-02	2.909e-02
CE	0.000e+00	9.122e-02	5.088e-02	8.493e-02	8.074e-02	7.761e-02	7.511e-02	7.303e-02	7.128e-02	6.980e-02	6.830e-02
PR	0.000e+00	2.160e-02	2.190e-02	2.408e-02	2.508e-02	2.546e-02	2.556e-02	2.551e-02	2.537e-02	2.518e-02	2.494e-02
MD	0.000e+00	6.150e-02	7.300e-02	7.889e-02	7.900e-02	8.050e-02	8.166e-02	8.250e-02	8.314e-02	8.397e-02	8.453e-02
PM	0.000e+00	6.767e-03	8.491e-03	7.887e-03	6.884e-03	5.933e-03	5.096e-03	4.376e-03	3.776e-03	3.286e-03	2.851e-03
SM	0.000e+00	9.120e-03	1.038e-02	1.164e-02	1.258e-02	1.336e-02	1.376e-02	1.410e-02	1.431e-02	1.441e-02	1.438e-02
EU	0.000e+00	1.124e-03	1.430e-03	1.863e-03	2.242e-03	2.544e-03	2.800e-03	2.986e-03	3.108e-03	3.177e-03	3.202e-03
GD	0.000e+00	1.602e-04	1.479e-04	6.167e-04	5.345e-04	1.325e-03	1.794e-03	2.338e-03	2.943e-03	3.589e-03	4.316e-03
SUMTCT	0.000e+00	9.991e-01	5.991e-01	9.991e-01	5.991e-01	9.990e-01	9.990e-01	9.990e-01	9.990e-01	9.990e-01	9.990e-01
TOTAL	0.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00

Command File and Output Data

```

-1
-1
-1
BAS ONE METRIC TON OF LMFBR FUEL (Core)
LIP 0 0 0
LIB 0 0 2 3 311 312 313 9 3 0 1 12
PMC 0 0 0 10
OPTL 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8
OPTA 8 8 8 7 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8
OPTF 8 8 8 7 6 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8
INP -1 1 -1 -1 1 1
MOV -1 1 0 1.0
BUP
IRP 30 123.25 1 2 4 2
IRP 60 123.25 2 3 4 0
IRP 90 123.25 3 4 4 0
IRP 180 123.25 4 5 4 0
IRP 270 123.25 5 6 4 0
IRP 360 123.25 6 7 4 0
IRP 450 123.25 7 8 4 0
IRP 540 123.25 8 9 4 0
IRP 630 123.25 9 10 4 0
IRP 720 123.25 10 11 4 0
IRP 822 123.25 11 12 4 0
BUP
TIT * IRRADIATION CF ONE METRIC TCN OF LMFBR FUEL (Core) *
OUT -12 1 -1 0
END
2 922350 1676.0 922380 813656.0 942380 2586
2 942390 101567 942400 46738.0 942410 24957 942420 9220 0 0.0
4 030000 1.0 050000 1.0 060000 89.4 070000 25.0 FUEL IMPUR
4 080000 134454.0 090000 10.7 110000 15.0 120000 2.0 FUEL IMPUR
4 130000 16.7 140000 12.1 150000 35.0 170000 5.3 FUEL IMPUR
4 200000 2.0 220000 1.0 230000 3.0 240000 4.0 FUEL IMPUR
4 250000 1.7 260000 18.0 270000 1.0 280000 24.0 FUEL IMPUR
4 290000 1.0 300000 40.3 420000 10.0 470000 0.1 FUEL IMPUR
4 480000 25.0 490000 2.0 500000 4.0 640000 2.5 FUEL IMPUR
4 740000 2.0 820000 1.0 830000 0.4 0 0.0 FUEL IMPUR
0

```

9 IRRADIATION OF ONE METRIC TON OF LMFBR FUEL (Core) *
 POWER= 1.23250e+02 MW, BURNUP= 1.01312e+05 MWD, FLUX= 5.11e+15 N/CM**2-SEC
 REACTIVITY AND BURNUP DATA
 BASIS= METRIC TON OF LMFBR FUEL (Core)

	0. S	30.0C	60.00	90.0C	180.00	270.0C	360.00	450.00	540.00	630.0C	720.00	822.00
TIME SEC	C.00e+00	2.59e+06	5.18e+06	7.78e+06	1.56e+07	2.33e+07	3.11e+07	3.89e+07	4.67e+07	5.44e+07	6.22e+07	7.10e+07
NEUT. FLUX	C.00e+0C	4.76e+15	4.79e+15	4.82e+15	4.87e+15	4.96e+15	5.03e+15	5.11e+15	5.18e+15	5.25e+15	5.33e+15	5.40e+15
SP PC*MM	C.00e+0C	1.23e+02	1.23e+02	1.23e+02	1.23e+02	1.23e+02	1.23e+02	1.23e+02	1.23e+02	1.23e+02	1.23e+02	1.23e+02
BURNUP MWD	C.00e+0C	3.70e+03	3.70e+03	3.70e+03	3.70e+03	3.70e+03	3.70e+03	3.70e+03	3.70e+03	3.70e+03	3.70e+03	3.70e+03
R IAFINITY	0.	1.43507	1.42941	1.42379	1.40706	1.39113	1.37676	1.36253	1.34929	1.33650	1.32378	1.31009
NEUT PRCDN	C.00e+0C	2.25e+03	2.26e+03	2.27e+03	2.23e+03	2.20e+03	2.17e+03	2.14e+03	2.11e+03	2.08e+03	2.05e+03	2.02e+03
NEUT DESTN	C.00e+0C	1.60e+03	1.59e+03	1.59e+03	1.59e+03	1.58e+03	1.57e+03	1.56e+03	1.56e+03	1.56e+03	1.55e+03	1.55e+03
TCT BURNUP	C.00e+0C	1.01e+05	1.01e+05	1.01e+05	1.01e+05	1.01e+05	1.01e+05	1.01e+05	1.01e+05	1.01e+05	1.01e+05	1.01e+05
AVG N FLUX	C.00e+0C	5.11e+15	5.11e+15	5.11e+15	5.11e+15	5.11e+15	5.11e+15	5.11e+15	5.11e+15	5.11e+15	5.11e+15	5.11e+15
AVG SP PUM	C.00e+0C	1.23e+02	1.23e+02	1.23e+02	1.23e+02	1.23e+02	1.23e+02	1.23e+02	1.23e+02	1.23e+02	1.23e+02	1.23e+02

SIZE OF MPA(1): MPA= 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000

THE NUMBER OF MCN-ZERO TERMS IN A=4932
 THE NUMBER OF MCN-ZERO FISSION PRODUCT YIELDS=3242
 ILITE= 0 IACT= 125 IFF= 879 ITOT=1008
 THE NUMBER OF MCN-ZERO NATURAL ABUNDANCES= 154
 THE NUMBER OF MCN-ZERO FNETCN YIELDS= 0
 THE MAXIMUM NUMBER OF TERMS IN AP= 2209

* IRRADIATION OF ONE METRIC TON OF LMFBR FUEL (Core) *

POWER= 1.23250e+02 MW, BURUP= 1.01312e+05 PWD, FLUX= 5.11e+15 N/CM^2-SEC
 4 SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS
 METRIC TON OF LMFBR FUEL (Core)

ACTINIDES+CAUGHTERS

	C. 5	30.0C	60.0C	90.0C	180.0C	270.0C	360.0C	450.0C	540.0C	630.0C	720.0C	822.0C
U235	1.700e-03	1.655e-03	1.612e-03	1.570e-03	1.448e-03	1.333e-03	1.227e-03	1.127e-03	1.035e-03	9.489e-04	8.692e-04	7.859e-04
U238	8.17e-01	8.144e-01	8.141e-01	8.137e-01	8.127e-01	8.117e-01	8.105e-01	8.093e-01	8.081e-01	8.069e-01	8.056e-01	8.040e-01
PU238	2.385e-03	2.380e-03	2.489e-03	2.440e-03	2.304e-03	2.191e-03	2.076e-03	1.981e-03	1.902e-03	1.836e-03	1.762e-03	1.722e-03
PU239	1.013e-01	1.011e-01	1.018e-01	1.022e-01	1.034e-01	1.045e-01	1.054e-01	1.064e-01	1.072e-01	1.080e-01	1.087e-01	1.054e-01
PU240	4.641e-03	4.665e-03	4.698e-03	4.727e-03	4.813e-03	4.904e-03	4.994e-03	5.086e-03	5.178e-03	5.270e-03	5.363e-03	5.410e-03
PU241	2.428e-03	2.370e-03	2.313e-03	2.259e-03	2.107e-03	1.970e-03	1.848e-03	1.740e-03	1.644e-03	1.560e-03	1.486e-03	1.415e-03
PU242	5.075e-03	5.154e-03	5.227e-03	5.296e-03	5.487e-03	5.653e-03	5.796e-03	5.918e-03	6.024e-03	6.111e-03	6.180e-03	6.250e-03
AM241	0.000e+00	9.387e-05	1.836e-04	2.692e-04	5.034e-04	7.060e-04	8.803e-04	1.029e-03	1.156e-03	1.264e-03	1.353e-03	1.437e-03
AM243	0.000e+00	6.176e-05	1.224e-04	1.840e-04	3.496e-04	5.522e-04	7.398e-04	9.226e-04	1.103e-03	1.282e-03	1.457e-03	1.632e-03
SUMTCT	1.000e+00	9.596e-01	9.936e-01	9.996e-01	9.994e-01	9.993e-01	9.991e-01	9.989e-01	9.988e-01	9.986e-01	9.984e-01	9.981e-01
TOTAL	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00

* IRRADIATION OF ONE METRIC TON OF LMFBR FUEL (Core) *

POWER= 1.23250e+02 MW, BURUP= 1.01312e+05 PWD, FLUX= 5.11e+15 N/CM^2-SEC
 4 SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS
 METRIC TON OF LMFBR FUEL (Core)

ACTINIDES+CAUGHTERS

	0. 5	30.0C	60.0C	90.0C	180.0C	270.0C	360.0C	450.0C	540.0C	630.0C	720.0C	822.0C
L	8.164e-01	8.160e-01	8.157e-01	8.154e-01	8.143e-01	8.131e-01	8.119e-01	8.106e-01	8.094e-01	8.080e-01	8.067e-01	8.051e-01
PU	1.836e-01	1.835e-01	1.836e-01	1.838e-01	1.844e-01	1.850e-01	1.857e-01	1.865e-01	1.873e-01	1.882e-01	1.891e-01	1.902e-01
AM	0.000e+00	1.568e-04	2.066e-04	4.547e-04	8.777e-04	1.271e-03	1.635e-03	1.974e-03	2.285e-03	2.582e-03	2.864e-03	3.140e-03
SUMTCT	1.000e+00	9.570e-01	9.936e-01	9.996e-01	9.995e-01	9.994e-01	9.993e-01	9.991e-01	9.988e-01	9.986e-01	9.984e-01	9.981e-01
TOTAL	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00

FISSION PRODUCTS

```
POWER= 1.3250E+02 PW. BURAP= 1.01312E+05 MW. FLUX= 5.11E+15 N/CM2-SEC
4 SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAMS ATOMS
METRIC TON OF LMFOR FUEL (CGRF)
```

[illegible]

```
POWER= 1.23250E+02 PW. DURADP= 1.01312E+05 MWD. FLUX= 5.110E15 N/CM2-SEC
      4 SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS
      METRIC TON (C= CARBON, S= SULFUR, SI= SILICON, O= OXYGEN)
```

C. 5	3C.00	60.00	90.00	180.00	270.0C	360.00	450.00	54C.00	630.0C	720.00	E22.0C
0.C0C.0C	2.3650-02	2.8330-02	2.9890-02	2.1060-02	3.1290-02	3.1270-02	3.1140-02	3.0940-02	3.C740-02	3.0510-02	3.C330-02
C.00C.0C	2.6423-02	2.6430-02	3.6450-02	2.6440-02	3.6400-02	3.6370-02	3.6230-02	3.6250-02	3.6250-02	3.6210-02	3.6300-02
0.00C.00	6.0200-05	1.5760-04	2.9560-04	5.5600-04	8.3220-04	1.0930-03	1.3340-03	1.5630-03	1.7780-03	1.9810-03	2.1970-03
C.00C.0C	3.4240-02	3.4740-02	3.4540-02	2.5130-02	3.5240-02	3.5240-02	3.5270-02	3.5250-02	3.5200-02	3.5340-02	3.5370-02
0.00C.0C	3.4190-02	3.4100-02	3.4090-02	2.4090-02	3.4080-02	3.4070-02	3.4060-02	3.4040-02	3.4030-02	3.4020-02	3.4010-02
C.00C.0C	3.3990-02	2.0950-02	3.0200-02	2.0840-02	3.0750-02	3.0660-02	3.0570-02	3.0470-02	3.0380-02	3.0290-02	3.0180-02
C.00C.0C	3.3650-02	2.0670-02	2.0670-02	2.0700-02	3.0740-02	3.0730-02	3.0740-02	3.0730-02	3.0710-02	3.0770-02	3.0700-02
C.00C.0C	2.6710-02	2.8740-02	2.8740-02	2.8740-02	2.8730-02	2.8710-02	2.8680-02	2.8660-02	2.8630-02	2.8610-02	2.8580-04
0.00C.0C	1.3120-02	2.8510-03	5.4010-03	2.7040-03	1.8030-03	1.3510-03	1.0800-03	8.9970-04	7.7080-04	6.7410-04	5.8970-04
C.00C.0C	1.1260-04	1.0570-03	7.7030-04	3.5670-04	2.3810-04	1.7870-04	1.4210-04	1.1940-04	1.C550-04	8.9750-05	7.8470-05
0.00C.0C	1.5040-02	1.8970-02	2.1740-02	2.4550-02	2.5490-02	2.5700-02	2.6260-02	2.6450-02	2.6590-02	2.6700-02	2.6780-02
C.00C.0C	1.6420-02	1.4880-02	1.1750-02	6.7410-03	4.5830-03	3.4530-03	2.7670-03	2.3080-03	1.9200-03	1.7370-03	1.5230-03
0.00C.0C	6.6750-03	1.1500-02	1.4660-02	1.9670-02	2.1790-02	2.2800-02	2.3510-02	2.3940-02	2.4790-02	2.4270-02	2.4710-02
0.00C.0C	2.3670-02	2.3700-02	2.3730-02	2.3760-02	2.3770-02	2.3700-02	2.3770-02	2.3770-02	2.3760-02	2.3760-02	2.3750-02
C.00C.0C	1.4360-03	7.1870-04	4.7110-04	2.3860-04	1.5930-04	1.1560-04	9.9550-05	7.9950-05	6.6470-05	6.0170-05	5.2710-05
0.00C.0C	1.3350-02	6.4880-03	5.5120-03	2.5080-03	1.5460-03	1.1370-03	2.0320-02	7.7330-04	6.6590-04	5.8170-04	5.1100-04
C.00C.0C	9.5320-03	1.6550-02	1.6800-02	1.9130-02	1.9800-02	2.0180-02	2.0300-02	2.0300-02	2.0390-02	2.0370-02	2.C320-02
0.00C.0C	1.4130-02	1.7700-03	1.8370-03	5.5120-04	6.3700-04	4.8000-04	3.6410-04	2.2340-04	2.7870-04	2.4530-04	2.1650-04
C.00C.0C	5.7840-03	7.5980-03	8.2350-03	8.4340-03	8.C530-03	7.5780-03	7.0570-03	6.4670-03	6.2690-03	5.8120-03	5.4020-03
0.00C.0C	4.7720-04	1.3620-04	2.3380-04	2.5100-04	7.7870-04	1.0050-03	1.2030-03	1.3760-03	1.5250-03	1.6540-03	1.7780-03
0.00C.0C	8.6700-03	6.9610-03	8.9320-03	8.9220-03	8.8890-03	8.8460-03	8.8180-03	8.7810-03	8.7450-03	8.7080-03	8.6670-03
C.00C.0C	2.2810-05	5.6140-05	1.5900-04	5.8810-04	9.9730-04	1.3930-03	1.7460-03	2.1140-03	2.3260-03	2.7360-03	3.0490-03
0.00C.0C	6.6430-03	6.3670-03	6.4550-03	6.4380-03	6.3500-03	6.2460-03	6.1380-03	6.0310-03	5.9260-03	5.8240-03	5.7120-03
0.00C.0C	5.2460-03	5.3360-03	5.2370-03	5.3040-03	5.2790-03	5.2530-03	5.2280-03	5.2020-03	5.1760-03	5.1500-02	5.1210-03
0.00C.0C	7.1600-05	1.3580-04	1.9380-04	2.6130-04	5.2700-04	6.8370-04	8.4970-04	1.0020-03	1.1610-03	1.3120-02	1.4280-03
C.00C.0C	3.6910-03	2.9680-03	3.9330-03	3.8570-03	3.7300-03	3.6190-03	3.5040-03	3.3530-03	3.2170-03	3.1860-02	3.0780-03
C.00C.0C	3.3060-03	2.3010-03	3.2940-03	3.2240-03	3.6670-03	3.7050-03	3.8770-03	3.9640-03	4.0050-03	4.1820-03	4.2860-03
0.00C.00	1.5360-03	2.0510-03	2.0290-03	2.0020-03	1.9550-03	1.9070-03	1.8590-03	1.8130-03	1.7700-03	1.7300-03	1.6670-03
0.00C.0C	1.5650-03	1.5620-03	1.5590-03	1.5520-03	1.5440-03	1.5370-03	1.5290-03	1.5210-03	1.5140-03	1.5060-03	1.4570-03
C.00C.0C	1.1170-03	5.9900-04	9.6180-04	5.3600-04	8.9730-04	8.6310-04	8.3850-04	8.1680-04	7.9530-04	7.8540-04	7.7350-04
0.00C.0C	3.2440-04	4.9210-04	5.7770-04	4.9890-04	7.6320-04	8.1190-04	8.5400-04	8.9240-04	9.3520-04	9.6460-04	1.C560-03
C.00C.0C	9.1760-01	5.8170-01	9.8300-01	5.8400-01	9.8300-01	9.8360-01	9.8310-01	9.8220-01	9.8190-01	9.8130-01	9.8050-01
0.00C.0C	1.0000-00	1.0000-00	1.0000-00	1.0000-00	1.0000-00	1.0000-00	1.0000-00	1.0000-00	1.0000-00	1.0000-00	1.0000-00

* IRRADIATION OF ONE METRIC TON OF LMFBR FUEL (CORE) *

POWER= 1.23250E+02 MW, BURNUP= 1.01312E+05 MWD, FLUX= 5.11E+15 N/CM^2-SEC

* SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS

METRIC TON OF LMFBR FUEL (CORE)

FISSION PRODUCTS

	0. S	30.0C	60.0C	90.0C	180.0C	270.0C	360.0C	450.0C	540.0C	630.0C	720.0C	822.0C
SE	C.000E+00	1.648E-03	1.650E-03	1.650E-03	1.650E-03	1.650E-03	1.649E-03	1.648E-03	1.647E-03	1.646E-03	1.645E-03	1.644E-03
SR	C.000E+00	9.668E-03	9.638E-03	9.631E-03	9.635E-03	9.642E-03	9.651E-03	9.659E-03	9.666E-03	9.673E-03	9.679E-03	9.686E-03
SB	C.000E+00	7.517E-03	7.930E-03	7.936E-03	7.951E-03	7.959E-03	7.966E-03	7.971E-03	7.975E-03	7.978E-03	7.980E-03	7.981E-03
SA	C.000E+00	2.587E-02	2.445E-02	2.342E-02	2.150E-02	2.049E-02	1.991E-02	1.954E-02	1.928E-02	1.909E-02	1.895E-02	1.882E-02
Y	C.000E+00	1.263E-02	1.218E-02	1.184E-02	1.113E-02	1.067E-02	1.038E-02	1.018E-02	1.004E-02	9.938E-03	9.861E-03	9.754E-03
ZR	C.000E+00	1.604E-01	5.915E-02	9.823E-02	5.632E-02	9.519E-02	9.431E-02	9.308E-02	9.380E-02	9.322E-02	9.345E-02	9.339E-02
NR	C.000E+00	2.662E-03	4.236E-03	4.835E-03	4.692E-03	3.852E-03	3.116E-03	2.567E-03	2.165E-03	1.855E-03	1.637E-03	1.428E-03
PC	C.000E+00	8.118E-02	8.018E-02	8.913E-02	9.340E-02	9.677E-02	9.908E-02	1.007E-01	1.015E-01	1.026E-01	1.032E-01	1.037E-01
TC	C.000E+00	2.535E-02	2.718E-02	2.775E-02	2.821E-02	2.823E-02	2.814E-02	2.801E-02	2.786E-02	2.769E-02	2.751E-02	2.730E-02
RU	C.000E+00	1.423E-01	1.365E-01	1.322E-01	1.244E-01	1.201E-01	1.173E-01	1.152E-01	1.136E-01	1.120E-01	1.112E-01	1.102E-01
RM	C.000E+00	8.549E-03	1.312E-02	1.645E-02	2.227E-02	2.483E-02	2.608E-02	2.671E-02	2.703E-02	2.715E-02	2.717E-02	2.709E-02
PC	C.000E+00	5.457E-02	5.803E-02	5.854E-02	6.110E-02	6.295E-02	6.493E-02	6.617E-02	6.761E-02	6.894E-02	7.015E-02	7.152E-02
AC	C.000E+00	9.144E-03	8.854E-03	8.746E-03	8.553E-03	8.450E-03	8.363E-03	8.283E-03	8.205E-03	8.138E-03	8.069E-03	7.955E-03
CD	C.000E+00	5.490E-03	5.861E-02	6.050E-03	6.182E-03	6.273E-03	6.317E-03	6.416E-03	6.486E-03	6.556E-03	6.626E-03	6.712E-03
SA	C.000E+00	5.282E-03	5.206E-03	5.181E-03	5.174E-03	5.189E-03	5.210E-03	5.232E-03	5.254E-03	5.276E-03	5.295E-03	5.316E-03
SB	C.000E+00	2.577E-03	2.348E-03	2.218E-03	2.177E-03	2.127E-03	2.084E-03	2.048E-03	2.012E-03	1.978E-03	1.943E-03	1.905E-03
TE	C.000E+00	2.105E-02	1.883E-02	1.800E-02	1.709E-02	1.677E-02	1.628E-02	1.554E-02	1.458E-02	1.347E-02	1.245E-02	1.145E-02
I	C.000E+00	1.691E-02	1.325E-02	1.198E-02	1.072E-02	1.030E-02	1.006E-02	9.905E-03	9.778E-03	9.687E-03	9.567E-03	9.400E-03
HE	C.000E+00	1.132E-01	1.143E-01	1.147E-01	1.153E-01	1.155E-01	1.156E-01	1.156E-01	1.157E-01	1.157E-01	1.158E-01	1.158E-01
CS	C.000E+00	8.525E-02	5.400E-02	9.614E-02	7.666E-02	9.813E-02	9.831E-02	9.835E-02	9.833E-02	9.826E-02	9.816E-02	9.802E-02
EA	C.000E+00	4.417E-02	2.901E-02	3.664E-02	2.417E-02	3.247E-02	3.322E-02	3.317E-02	3.322E-02	3.323E-02	3.348E-02	3.269E-02
LA	C.000E+00	3.073E-02	2.994E-02	2.957E-02	2.915E-02	2.900E-02	2.891E-02	2.884E-02	2.875E-02	2.875E-02	2.871E-02	2.867E-02
CE	C.000E+00	7.575E-02	7.582E-02	7.461E-02	7.051E-02	6.776E-02	6.579E-02	6.426E-02	6.300E-02	6.194E-02	6.104E-02	6.015E-02
PR	C.000E+00	1.747E-02	1.805E-02	1.924E-02	2.201E-02	2.336E-02	2.406E-02	2.446E-02	2.470E-02	2.468E-02	2.456E-02	2.452E-02
AC	C.000E+00	5.621E-02	6.157E-02	6.356E-02	6.676E-02	6.875E-02	7.029E-02	7.155E-02	7.263E-02	7.355E-02	7.436E-02	7.515E-02
PM	C.000E+00	6.795E-03	6.198E-03	8.726E-03	6.845E-02	8.437E-03	7.939E-03	7.428E-03	6.960E-03	6.514E-03	6.101E-03	5.673E-03
SM	C.000E+00	1.517E-02	1.572E-02	1.605E-02	1.688E-02	1.761E-02	1.827E-02	1.888E-02	1.944E-02	1.955E-02	2.041E-02	2.089E-02
EU	C.000E+00	3.594E-03	3.337E-03	3.287E-03	3.207E-03	3.163E-03	3.131E-03	3.105E-03	3.084E-03	3.058E-03	3.048E-03	3.032E-03
GC	C.000E+00	1.305E-02	1.476E-02	1.565E-02	1.710E-02	1.753E-02	1.860E-02	1.920E-02	1.977E-02	2.022E-02	2.056E-02	2.140E-02
SUMTCT	C.000E+00	9.584E-01	9.983E-01	9.984E-01	5.984E-01	9.984E-01	9.985E-01	9.985E-01	9.985E-01	9.986E-01	9.986E-01	9.986E-01
TOTAL	C.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

Appendix G: LMFBR - Axial Blanket, 100 GWd/MTIHM

Command File and Output Data

```

-1
-1
-1
BAS ONE METRIC TON OF LMFBR FUEL (Axial Blanket)
LIP 0 0 0
LIB 0 0 2 3 314 315 316 9 3 0 1 13
PMC 0 0 0 10
OPTL 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8
OPTA 8 8 8 7 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8
OPTF 8 8 8 7 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8
IMP -1 1 -1 -1 1 1
MOV -1 1 0 1.0
SUP
IRP 30 6.89 1 2 4 2
IRP 60 6.89 2 3 4 0
IRP 90 6.89 3 4 4 0
IRP 180 6.89 4 5 4 0
IRP 270 6.89 5 6 4 0
IRP 360 6.89 6 7 4 0
IRP 450 6.89 7 8 4 0
IRP 540 6.89 8 9 4 0
IRP 630 6.89 9 10 4 0
IRP 720 6.89 10 11 4 0
IRP 822 6.89 11 12 4 0
SUP
TIT * IRRADIATION OF ONE METRIC TON OF LMFBR FUEL (Axial Blanket) *
OUT -12 1 -1 0
END
2 522350 2000.0 922380 998000.0 0 0.0
4 030000 1.0 050000 1.0 060000 89.4 070000 25.0 FUEL IMPUR
4 080000 134454.0 090000 10.7 110000 15.0 120000 2.0 FUEL IMPUR
4 130000 16.7 140000 12.1 150000 35.0 170000 5.3 FUEL IMPUR
4 200000 2.0 220000 1.0 230000 3.0 240000 4.0 FUEL IMPUR
4 250000 1.7 260000 18.0 270000 1.0 280000 24.0 FUEL IMPUR
4 290000 1.0 300000 40.3 420000 10.0 470000 0.1 FUEL IMPUR
4 480000 25.0 490000 2.0 500000 4.0 640000 2.5 FUEL IMPUR
4 740000 2.0 820000 1.0 830000 0.4 0 0.0 FUEL IMPUR
0

```

* IRRADIATION OF ONE METRIC TON OF LMFBR FUEL (Axial Blanket) *
 POWER= 6.99000e+00 MW, BURNUP= 5.66358e+03 MWD, FLUX= 1.33e+15 N/CM^2-SEC
 REACTIVITY AND BURNUP DATA
 BASIS= METRIC TON OF LMFBR FUEL (Axial Blanket)

	0. S	30.00	60.00	90.00	180.00	270.00	360.00	450.00	540.00	630.00	720.00	822.00
TIME, SEC	0.00e+00	2.59e+06	5.18e+06	7.78e+06	1.56e+07	2.33e+07	3.11e+07	3.89e+07	4.67e+07	5.44e+07	6.22e+07	7.10e+07
NEUT. FLUX	0.00e+00	2.73e+15	2.37e+15	2.09e+15	1.79e+15	1.46e+15	1.30e+15	1.17e+15	1.05e+15	1.02e+15	9.56e+14	9.08e+14
SP POW, MW	0.00e+00	6.89e+00	6.89e+00	6.89e+00	6.89e+00	6.89e+00	6.89e+00	6.89e+00	6.89e+00	6.89e+00	6.89e+00	6.89e+00
BURNUP, MWD	0.00e+00	2.07e+02	2.07e+02	2.07e+02	6.20e+02	6.20e+02	6.20e+02	6.20e+02	6.20e+02	6.20e+02	6.20e+02	6.20e+02
K INFINITY	0.	1.23562	0.26573	0.29106	0.35120	0.39725	0.43098	0.46274	0.48859	0.51362	0.53876	0.56100
NEUT PRODN	0.00e+00	2.51e+02	2.07e+02	3.19e+02	3.93e+02	4.53e+02	5.04e+02	5.49e+02	5.89e+02	6.26e+02	6.59e+02	6.93e+02
NEUT DESTN	0.00e+00	1.01e+03	1.08e+03	1.09e+03	1.12e+03	1.14e+03	1.17e+03	1.19e+03	1.21e+03	1.22e+03	1.22e+03	1.24e+03
TOT BURNUP	0.00e+00	5.66e+03	5.66e+03	5.66e+03	5.66e+03	5.66e+03	5.66e+03	5.66e+03	5.66e+03	5.66e+03	5.66e+03	5.66e+03
AVG N FLUX	0.00e+00	1.33e+15	1.33e+15	1.33e+15	1.33e+15	1.33e+15	1.33e+15	1.33e+15	1.33e+15	1.33e+15	1.33e+15	1.33e+15
AVG SP POW	0.00e+00	6.89e+00	6.89e+00	6.89e+00	6.89e+00	6.89e+00	6.89e+00	6.89e+00	6.89e+00	6.89e+00	6.89e+00	6.89e+00

SIZE OF MARR(1): MMAX= 1 N= 165 MMAX= 2 N= 255 MMAX= 3 N= 69 MMAX= 4 N= 21 MMAX= 5 N= 26 MMAX= 6 N= 41
 MMAX= 7 N= 25 MMAX= 8 N= 0 MMAX= 9 N= 0 MMAX= 10 N= 0 MMAX= 11 N= 0 MMAX= 12 N= 0

THE NUMBER OF NON-ZERO TERMS IN A4932
 THE NUMBER OF NON-ZERO FISSION PRODUCT YIELDS=3242
 ILITE= 0 IACT= 125 IFF= 879 ITCT=1008
 THE NUMBER OF NON-ZERO NATURAL ABUNDANCES= 154
 THE NUMBER OF NON-ZERO FICTON YIELDS= 0
 THE MAXIMUM NUMBER OF TERMS IN AP= 2209

OUTPUT UNIT = 11

* IRRADIATION OF ONE PETRIC TON OF LMFOR FUEL (Axis Blanket) *

POWER= 6.89C00e+00 MW, BURNUP= 5.66358e+03 MW, FLUX= 1.33e+15 N/CM^2-SEC
 & SUPMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS
 METRIC TON OF LMFOR FUEL (Axis Blanket)

ACTINIDES+CAUGHTERS

	0.5	30.00	60.00	90.00	180.00	270.00	360.00	450.00	540.00	630.00	720.00	822.00
U235	2.028e-03	1.578e-03	1.938e-03	1.903e-03	1.815e-03	1.753e-03	1.696e-03	1.647e-03	1.602e-03	1.561e-03	1.524e-03	1.486e-03
U238	9.980e-01	9.553e-01	9.308e-01	9.108e-01	8.862e-01	8.623e-01	8.391e-01	8.168e-01	7.954e-01	7.732e-01	7.507e-01	7.280e-01
PU239	0.000e+00	2.282e-03	4.767e-03	6.718e-03	1.152e-02	1.533e-02	1.862e-02	2.150e-02	2.405e-02	2.630e-02	2.856e-02	3.079e-02
PL240	0.000e+00	9.202e-06	3.124e-05	6.115e-05	1.753e-04	3.105e-04	4.635e-04	6.249e-04	7.942e-04	9.672e-04	1.145e-03	1.339e-03
SUMTCT	1.000e+00	9.597e-01	9.997e-01	9.997e-01	9.997e-01	9.997e-01	9.997e-01	9.997e-01	9.997e-01	9.997e-01	9.997e-01	9.997e-01
TOTAL	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00

OUTPUT UNIT = 11

* IRRADIATION OF ONE PETRIC TON OF LMFOR FUEL (Axis Blanket) *

POWER= 6.89C00e+00 MW, BURNUP= 5.66358e+03 MW, FLUX= 1.33e+15 N/CM^2-SEC
 & SUPMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS
 METRIC TON OF LMFOR FUEL (Axis Blanket)

ACTINIDES+CAUGHTERS

	C.5	30.00	60.00	90.00	180.00	270.00	360.00	450.00	540.00	630.00	720.00	822.00
U	1.000e+00	9.573e-01	9.950e-01	9.930e-01	9.881e-01	9.842e-01	9.807e-01	9.777e-01	9.745e-01	9.724e-01	9.701e-01	9.677e-01
PU	0.000e+00	2.291e-03	4.738e-03	6.779e-03	1.170e-02	1.565e-02	1.909e-02	2.214e-02	2.490e-02	2.743e-02	2.974e-02	3.218e-02
SUMTCT	1.000e+00	9.597e-01	9.997e-01	9.998e-01	9.998e-01	9.998e-01	9.998e-01	9.998e-01	9.998e-01	9.998e-01	9.998e-01	9.998e-01
TOTAL	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00

FISSION PRODUCTS

* IRRADIATION OF ONE PETRIC TON OF LMFBR FUEL (Axial Blanket) *

POWER= 6.89C00e+00 MW, BURNUP= 5.6358e+03 MW, FLUX= 1.33e+15 W/CM2-2-SEC

* SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS

METRIC TON OF LMFBR FUEL (Axial Blanket)

	0.5	30.00	60.00	90.00	180.00	270.00	360.00	450.00	540.00	630.00	720.00	822.00
SR 81	0.000e+00	1.661e-03	1.016e-03	9.786e-04	5.095e-04	0.659e-04	8.326e-04	8.071e-04	7.862e-04	7.691e-04	7.550e-04	7.416e-04
SE 82	0.000e+00	1.402e-03	1.538e-03	1.489e-03	1.395e-03	1.336e-03	1.291e-03	1.257e-03	1.229e-03	1.206e-03	1.186e-03	1.170e-03
SR 83	0.000e+00	2.504e-03	2.456e-03	2.401e-03	2.304e-03	2.241e-03	2.193e-03	2.155e-03	2.128e-03	2.106e-03	2.075e-03	2.054e-03
SR 84	0.000e+00	4.167e-03	4.148e-03	4.148e-03	3.965e-03	3.851e-03	3.766e-03	3.702e-03	3.650e-03	3.608e-03	3.574e-03	3.541e-03
SR 85	0.000e+00	3.440e-03	3.374e-03	3.318e-03	3.202e-03	3.130e-03	3.077e-03	3.037e-03	3.006e-03	2.981e-03	2.961e-03	2.942e-03
SR 86	0.000e+00	6.114e-03	6.110e-03	6.100e-03	6.162e-03	5.975e-03	5.837e-03	5.731e-03	5.645e-03	5.575e-03	5.517e-03	5.461e-03
SR 87	0.000e+00	8.466e-03	8.238e-03	8.062e-03	7.712e-03	7.491e-03	7.327e-03	7.202e-03	7.100e-03	7.016e-03	6.947e-03	6.880e-03
SR 88	0.000e+00	1.203e-02	1.166e-02	1.135e-02	1.077e-02	1.039e-02	1.011e-02	9.853e-03	9.718e-03	9.575e-03	9.458e-03	9.346e-03
SR 89	0.000e+00	1.148e-02	1.108e-02	1.078e-02	1.039e-02	1.000e-02	9.718e-03	9.458e-03	9.218e-03	8.998e-03	8.798e-03	8.618e-03
SR 90	0.000e+00	2.498e-03	4.704e-03	6.189e-03	8.680e-03	9.838e-03	1.039e-02	1.066e-02	1.080e-02	1.087e-02	1.090e-02	1.092e-02
SR 91	0.000e+00	1.717e-02	1.663e-02	1.622e-02	1.539e-02	1.486e-02	1.446e-02	1.415e-02	1.388e-02	1.366e-02	1.347e-02	1.328e-02
SR 92	0.000e+00	1.632e-02	1.578e-02	1.535e-02	1.420e-02	1.338e-02	1.273e-02	1.228e-02	1.197e-02	1.170e-02	1.146e-02	1.125e-02
SR 93	0.000e+00	2.115e-02	2.080e-02	2.047e-02	1.978e-02	1.936e-02	1.902e-02	1.876e-02	1.856e-02	1.839e-02	1.825e-02	1.812e-02
SR 94	0.000e+00	2.418e-02	2.399e-02	2.374e-02	2.314e-02	2.274e-02	2.243e-02	2.215e-02	2.199e-02	2.183e-02	2.169e-02	2.156e-02
SR 95	0.000e+00	2.221e-02	2.213e-02	2.206e-02	2.193e-02	2.185e-02	2.180e-02	2.176e-02	2.173e-02	2.171e-02	2.169e-02	2.167e-02
SR 96	0.000e+00	1.356e-03	4.774e-03	5.648e-03	5.203e-03	4.255e-03	3.398e-03	2.772e-03	2.319e-03	1.866e-03	1.734e-03	1.515e-03
SR 97	0.000e+00	6.050e-03	2.162e-03	3.997e-03	5.225e-03	1.307e-02	1.564e-02	1.735e-02	1.852e-02	1.935e-02	2.000e-02	2.058e-02
SR 98	0.000e+00	2.632e-02	2.638e-02	2.628e-02	2.608e-02	2.595e-02	2.575e-02	2.570e-02	2.565e-02	2.560e-02	2.558e-02	2.556e-02
SR 99	0.000e+00	2.603e-02	2.605e-02	2.605e-02	2.605e-02	2.605e-02	2.605e-02	2.605e-02	2.605e-02	2.605e-02	2.605e-02	2.605e-02
SR 100	0.000e+00	2.781e-02	2.785e-02	2.788e-02	2.795e-02	2.800e-02	2.805e-02	2.808e-02	2.811e-02	2.814e-02	2.817e-02	2.819e-02
SR 101	0.000e+00	4.142e-03	2.052e-03	1.343e-03	7.043e-04	4.555e-04	3.373e-04	2.675e-04	2.218e-04	1.894e-04	1.653e-04	1.459e-04
SR 102	0.000e+00	2.475e-02	2.694e-02	2.764e-02	2.822e-02	2.840e-02	2.845e-02	2.847e-02	2.846e-02	2.844e-02	2.842e-02	2.839e-02
SR 103	0.000e+00	2.571e-02	2.992e-02	3.008e-02	3.039e-02	3.058e-02	3.073e-02	3.083e-02	3.092e-02	3.099e-02	3.104e-02	3.109e-02
SR 104	0.000e+00	2.599e-02	2.012e-02	3.021e-02	2.036e-02	3.044e-02	3.048e-02	3.050e-02	3.051e-02	3.052e-02	3.051e-02	3.050e-02
SR 105	0.000e+00	2.585e-02	2.014e-02	3.036e-02	2.082e-02	3.113e-02	3.137e-02	3.155e-02	3.171e-02	3.185e-02	3.197e-02	3.208e-02
SR 106	0.000e+00	2.628e-02	1.659e-02	1.377e-02	8.270e-03	6.237e-03	4.788e-03	3.879e-03	3.263e-03	2.816e-03	2.476e-03	2.183e-03
SR 107	0.000e+00	3.576e-03	9.835e-03	1.308e-02	1.881e-02	2.187e-02	2.364e-02	2.477e-02	2.556e-02	2.614e-02	2.658e-02	2.694e-02
SR 108	0.000e+00	2.315e-02	2.351e-02	2.445e-02	2.549e-02	2.613e-02	2.660e-02	2.695e-02	2.723e-02	2.745e-02	2.764e-02	2.781e-02
SR 109	0.000e+00	1.265e-03	5.074e-03	9.498e-03	2.439e-02	5.252e-02	6.511e-02	7.686e-02	8.781e-02	9.804e-02	1.050e-01	1.090e-01
SR 110	0.000e+00	1.285e-03	7.244e-04	4.902e-04	2.717e-04	1.808e-04	1.367e-04	1.099e-04	9.213e-05	7.530e-05	6.955e-05	6.135e-05
SR 111	0.000e+00	1.605e-02	1.734e-02	1.801e-02	1.905e-02	1.963e-02	2.002e-02	2.020e-02	2.031e-02	2.038e-02	2.042e-02	2.044e-02
SR 112	0.000e+00	1.175e-02	1.220e-02	1.245e-02	1.258e-02	1.267e-02	1.270e-02	1.271e-02	1.271e-02	1.271e-02	1.271e-02	1.271e-02
SR 113	0.000e+00	4.539e-04	8.597e-04	1.270e-03	2.465e-03	3.622e-03	4.714e-03	5.733e-03	6.680e-03	7.557e-03	8.368e-03	9.112e-03
SR 114	0.000e+00	7.046e-03	7.821e-03	8.281e-03	9.177e-03	9.732e-03	1.014e-02	1.045e-02	1.071e-02	1.091e-02	1.107e-02	1.125e-02
SR 115	0.000e+00	4.751e-03	5.253e-03	5.832e-03	6.382e-03	6.860e-03	7.223e-03	7.504e-03	7.736e-03	7.928e-03	8.086e-03	8.243e-03
SR 116	0.000e+00	3.454e-03	2.846e-03	4.123e-03	4.643e-03	5.200e-03	5.780e-03	6.370e-03	6.960e-03	7.550e-03	8.140e-03	8.730e-03
SR 117	0.000e+00	2.528e-03	2.588e-03	2.633e-03	2.724e-03	2.780e-03	2.820e-03	2.851e-03	2.875e-03	2.895e-03	2.911e-03	2.927e-03
SR 118	0.000e+00	1.444e-03	1.778e-03	1.890e-03	1.976e-03	1.997e-03	1.995e-03	1.989e-03	1.982e-03	1.975e-03	1.970e-03	1.964e-03
SR 119	0.000e+00	1.682e-03	1.857e-03	1.916e-03	1.724e-03	1.666e-03	1.615e-03	1.577e-03	1.547e-03	1.523e-03	1.504e-03	1.485e-03
SR 120	0.000e+00	1.774e-03	1.692e-03	1.627e-03	1.500e-03	1.420e-03	1.357e-03	1.309e-03	1.269e-03	1.237e-03	1.212e-03	1.187e-03
SR 121	0.000e+00	1.472e-03	1.397e-03	1.340e-03	1.232e-03	1.145e-03	1.112e-03	1.073e-03	1.041e-03	1.014e-03	9.939e-04	9.741e-04
SR 122	0.000e+00	1.174e-03	1.383e-03	1.344e-03	1.226e-03	1.136e-03	1.060e-03	9.990e-04	9.478e-04	8.954e-04	8.702e-04	8.356e-04
SR 123	0.000e+00	1.778e-03	1.296e-03	1.231e-03	1.112e-03	1.038e-03	9.802e-04	9.364e-04	9.005e-04	8.714e-04	8.481e-04	8.258e-04
SR 124	0.000e+00	1.296e-03	1.317e-03	1.256e-03	1.135e-03	1.060e-03	1.001e-03	9.557e-04	9.189e-04	8.890e-04	8.652e-04	8.422e-04
SR 125	0.000e+00	1.249e-03	1.270e-03	1.211e-03	1.097e-03	1.026e-03	9.709e-04	9.250e-04	8.947e-04	8.699e-04	8.449e-04	8.235e-04
SR 126	0.000e+00	1.223e-03	1.246e-03	1.188e-03	1.077e-03	1.009e-03	9.532e-04	9.147e-04	8.815e-04	8.566e-04	8.322e-04	8.129e-04
SR 127	0.000e+00	1.254e-03	1.273e-03	1.212e-03	1.097e-03	1.026e-03	9.692e-04	9.268e-04	8.925e-04	8.677e-04	8.441e-04	8.216e-04
SR 128	0.000e+00	1.208e-03	1.265e-03	1.216e-03	1.106e-03	1.035e-03	9.773e-04	9.334e-04	8.973e-04	8.677e-04	8.441e-04	8.216e-04
SR 129	0.000e+00	1.462e-03	1.375e-03	1.310e-03	1.187e-03	1.110e-03	1.050e-03	1.005e-03	9.678e-04	9.376e-04	9.136e-04	8.904e-04
SR 130	0.000e+00	1.336e-03	1.277e-03	1.233e-03	1.153e-03	1.106e-03	1.063e-03	1.031e-03	1.003e-03	9.792e-04	9.558e-04	9.402e-04

FISSION PRODUCTS

* IRRADIATION OF ONE METRIC TON OF LMFR FUEL (Axial Blanket) *

POWER= 6.89C00+00 MW, BURNUP= 5.63558+03 MWD, FLUX= 1.33+15 W/CM2-SEC

4. SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS

METRIC TON OF LMFR FUEL (Axial Blanket)

	C. 5	3C.00	6C.00	90.00	180.00	270.00	360.00	450.00	540.00	630.00	720.00	822.00
SM124	C.00C+0C	1.174E-03	1.678E-03	1.406E-03	1.470E-03	1.385E-03	1.318E-03	1.267E-03	1.226E-03	1.192E-03	1.166E-03	1.140E-03
SM125	C.00C+0C	1.402E-03	1.843E-03	1.814E-03	1.681E-03	1.567E-03	1.466E-03	1.381E-03	1.306E-03	1.240E-03	1.183E-03	1.125E-03
SM126	C.00C+0C	2.435E-03	2.352E-03	2.276E-03	2.165E-03	2.089E-03	2.029E-03	1.983E-03	1.946E-03	1.916E-03	1.892E-03	1.869E-03
Y1127	C.00C+0C	2.155E-03	2.871E-03	2.566E-03	2.023E-03	3.040E-03	3.025E-03	3.011E-03	2.976E-03	2.957E-03	2.940E-03	2.920E-03
Y1128	C.00C+0C	5.163E-03	5.452E-03	5.365E-03	5.200E-03	5.095E-03	5.013E-03	4.950E-03	4.898E-03	4.856E-03	4.823E-03	4.795E-03
Y1129	C.00C+0C	6.470E-03	6.843E-03	6.948E-03	7.094E-03	7.148E-03	7.182E-03	7.164E-03	7.158E-03	7.151E-03	7.143E-03	7.134E-03
Y1130	C.00C+0C	1.101E-02	1.198E-02	1.196E-02	1.193E-02	1.191E-02	1.190E-02	1.188E-02	1.187E-02	1.186E-02	1.185E-02	1.185E-02
Y1131	C.00C+0C	6.150E-03	2.574E-03	2.393E-03	1.317E-03	8.560E-04	6.364E-04	5.059E-04	4.202E-04	3.592E-04	3.135E-04	2.750E-04
Y1132	C.00C+0C	4.123E-03	2.019E-03	1.322E-03	7.125E-04	4.618E-04	3.425E-04	2.718E-04	2.255E-04	1.926E-04	1.680E-04	1.473E-04
Y1133	C.00C+0C	2.166E-02	2.286E-02	2.388E-02	2.458E-02	2.498E-02	2.521E-02	2.537E-02	2.549E-02	2.558E-02	2.566E-02	2.573E-02
Y1134	C.00C+0C	1.434E-03	7.131E-04	4.680E-04	2.464E-04	1.596E-04	1.183E-04	9.288E-05	7.785E-05	6.488E-05	5.197E-05	5.082E-05
Y1135	C.00C+0C	7.651E-03	4.035E-03	2.672E-03	1.501E-03	9.728E-04	7.200E-04	5.722E-04	4.756E-04	4.033E-04	3.545E-04	3.109E-04
Y1136	C.00C+0C	2.443E-02	2.728E-02	2.901E-02	2.947E-02	3.107E-02	3.133E-02	3.146E-02	3.155E-02	3.160E-02	3.168E-02	3.173E-02
Y1137	C.00C+0C	3.117E-02	3.526E-02	3.531E-02	3.528E-02	3.542E-02	3.546E-02	3.548E-02	3.548E-02	3.551E-02	3.552E-02	3.553E-02
Y1138	C.00C+0C	3.076E-02	3.095E-02	3.148E-02	3.224E-02	3.268E-02	3.299E-02	3.322E-02	3.341E-02	3.356E-02	3.367E-02	3.379E-02
Y1139	C.00C+0C	3.671E-02	3.097E-02	3.117E-02	3.155E-02	3.180E-02	3.198E-02	3.213E-02	3.224E-02	3.233E-02	3.241E-02	3.248E-02
Y1140	C.00C+0C	2.611E-02	2.834E-02	2.850E-02	2.880E-02	2.895E-02	2.905E-02	2.910E-02	2.913E-02	2.914E-02	2.915E-02	2.915E-02
Y1141	C.00C+0C	2.650E-02	2.854E-02	2.901E-02	2.930E-02	2.948E-02	2.962E-02	2.973E-02	2.982E-02	2.989E-02	2.994E-02	3.000E-02
Y1142	C.00C+0C	1.216E-02	1.892E-03	5.401E-03	2.937E-03	1.854E-03	1.379E-03	1.037E-03	9.111E-04	7.789E-04	6.799E-04	5.563E-04
Y1143	C.00C+0C	1.727E-03	1.061E-03	7.298E-04	2.734E-04	2.443E-04	1.847E-04	1.447E-04	1.202E-04	1.028E-04	8.978E-05	7.872E-05
Y1144	C.00C+0C	1.247E-02	1.842E-02	2.127E-02	2.399E-02	2.505E-02	2.557E-02	2.589E-02	2.611E-02	2.626E-02	2.638E-02	2.647E-02
Y1145	C.00C+0C	1.857E-02	1.439E-02	1.142E-02	6.766E-03	4.600E-03	3.435E-03	2.775E-03	2.315E-03	1.968E-03	1.732E-03	1.525E-03
Y1146	C.00C+0C	6.128E-03	1.079E-02	1.332E-02	1.883E-02	2.114E-02	2.239E-02	2.315E-02	2.367E-02	2.404E-02	2.432E-02	2.456E-02
Y1147	C.00C+0C	2.407E-02	2.612E-02	2.414E-02	2.415E-02	2.415E-02	2.415E-02	2.415E-02	2.415E-02	2.415E-02	2.415E-02	2.415E-02
Y1148	C.00C+0C	1.618E-03	7.955E-04	5.182E-04	2.494E-04	1.733E-04	1.279E-04	1.011E-04	8.366E-05	7.131E-05	6.210E-05	5.437E-05
Y1149	C.00C+0C	1.102E-02	6.872E-03	4.732E-03	2.503E-03	1.630E-03	1.200E-03	9.066E-04	7.966E-04	6.803E-04	5.935E-04	5.212E-04
Y1150	C.00C+0C	1.612E-02	1.507E-02	1.742E-02	1.967E-02	2.049E-02	2.085E-02	2.114E-02	2.120E-02	2.126E-02	2.126E-02	2.126E-02
Y1151	C.00C+0C	2.466E-02	1.951E-02	1.845E-02	1.852E-02	1.876E-02	1.876E-02	1.876E-02	1.876E-02	1.876E-02	1.876E-02	1.876E-02
Y1152	C.00C+0C	7.505E-04	1.542E-03	2.749E-03	4.104E-03	5.702E-03	7.073E-03	8.259E-03	9.287E-03	1.018E-02	1.097E-02	1.174E-02
Y1153	C.00C+0C	1.750E-02	1.738E-02	1.748E-02	1.893E-02	1.672E-02	1.655E-02	1.641E-02	1.630E-02	1.621E-02	1.613E-02	1.605E-02
Y1154	C.00C+0C	1.535E-02	1.518E-02	1.504E-02	1.494E-02	1.484E-02	1.473E-02	1.462E-02	1.451E-02	1.440E-02	1.431E-02	1.428E-02
Y1155	C.00C+0C	5.405E-03	2.068E-02	2.047E-03	1.053E-03	6.807E-04	5.016E-04	3.971E-04	3.284E-04	2.601E-04	2.444E-04	2.140E-04
Y1156	C.00C+0C	6.225E-03	6.238E-03	8.264E-03	9.235E-03	9.028E-03	8.703E-03	8.367E-03	8.040E-03	7.732E-03	7.443E-03	7.136E-03
Y1157	C.00C+0C	5.647E-05	1.462E-04	2.529E-04	5.873E-04	6.641E-04	1.140E-03	1.396E-03	1.634E-03	1.856E-03	2.067E-03	2.259E-03
Y1158	C.00C+0C	9.508E-03	5.709E-03	9.630E-03	9.372E-03	9.291E-03	9.229E-03	9.177E-03	9.133E-03	9.098E-03	9.063E-03	9.030E-03
Y1159	C.00C+0C	2.566E-05	9.564E-05	1.789E-04	4.204E-04	7.904E-04	9.324E-04	1.055E-03	1.142E-03	1.200E-03	1.256E-03	1.315E-03
Y1160	C.00C+0C	6.489E-03	6.815E-03	6.873E-03	6.822E-03	6.745E-03	6.638E-03	6.550E-03	6.524E-03	6.458E-03	6.414E-03	6.359E-03
Y1161	C.00C+0C	5.610E-03	5.565E-03	5.531E-03	5.470E-03	5.396E-03	5.308E-03	5.200E-03	5.074E-03	4.938E-03	4.793E-03	4.639E-03
Y1162	C.00C+0C	3.605E-03	3.697E-03	3.712E-03	3.689E-03	3.653E-03	3.612E-03	3.574E-03	3.538E-03	3.504E-03	3.473E-03	3.439E-03
Y1163	C.00C+0C	2.650E-03	2.744E-03	2.819E-03	2.879E-03	2.916E-03	2.940E-03	2.953E-03	2.958E-03	2.963E-03	2.968E-03	2.973E-03
Y1164	C.00C+0C	1.658E-03	1.751E-03	1.780E-03	1.803E-03	1.806E-03	1.802E-03	1.797E-03	1.793E-03	1.789E-03	1.786E-03	1.783E-03
Y1165	C.00C+0C	1.678E-03	1.144E-03	1.141E-03	1.141E-03	1.141E-03	1.141E-03	1.141E-03	1.141E-03	1.141E-03	1.141E-03	1.141E-03
Y1166	C.00C+0C	9.644E-01	9.888E-01	9.902E-01	9.910E-01	9.906E-01	9.904E-01	9.902E-01	9.897E-01	9.893E-01	9.888E-01	9.884E-01
TOTAL	C.00C+0C	1.100E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00

OUTPUT UNIT = 11

• IRRADIATION OF ONE METRIC TON OF LPFR FUEL (Axial Blanket) •
 POWER= 6.89000e+00 MW, BURNUP= 5.66358e+03 MW, FLUX= 1.33e+15 N/CM^2-SEC
 & SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS
 METRIC TON OF LPFR FUEL (Axial Blanket)

FISSION PRODUCTS

	G. S	30.00	60.00	90.00	180.00	270.00	360.00	450.00	540.00	630.00	720.00	822.00
SE	0.000e+00	2.730e-03	2.634e-03	2.561e-03	2.418e-03	2.328e-03	2.268e-03	2.208e-03	2.165e-03	2.131e-03	2.102e-03	2.075e-03
BR	0.000e+00	1.080e-03	1.023e-03	9.644e-04	9.125e-04	8.678e-04	8.340e-04	8.082e-04	7.871e-04	7.698e-04	7.557e-04	7.430e-04
KR	0.000e+00	1.475e-02	1.431e-02	1.397e-02	1.334e-02	1.295e-02	1.265e-02	1.243e-02	1.224e-02	1.209e-02	1.197e-02	1.184e-02
RB	0.000e+00	1.192e-02	1.162e-02	1.138e-02	1.092e-02	1.063e-02	1.041e-02	1.024e-02	1.011e-02	1.000e-02	9.910e-03	9.824e-03
SR	0.000e+00	4.220e-02	3.852e-02	3.588e-02	3.117e-02	2.862e-02	2.704e-02	2.598e-02	2.519e-02	2.458e-02	2.410e-02	2.365e-02
Y	0.000e+00	1.577e-02	1.863e-02	1.777e-02	1.602e-02	1.491e-02	1.415e-02	1.362e-02	1.322e-02	1.291e-02	1.267e-02	1.245e-02
ZR	0.000e+00	1.211e-01	1.188e-01	1.170e-01	1.132e-01	1.107e-01	1.089e-01	1.076e-01	1.065e-01	1.057e-01	1.050e-01	1.044e-01
NB	0.000e+00	3.234e-03	4.818e-03	5.498e-03	5.221e-03	4.256e-03	3.607e-03	2.779e-03	2.358e-03	1.991e-03	1.735e-03	1.519e-03
MC	0.000e+00	8.639e-02	8.647e-02	8.989e-02	5.491e-02	9.874e-02	1.014e-01	1.032e-01	1.044e-01	1.053e-01	1.055e-01	1.065e-01
TC	0.000e+00	2.512e-02	2.712e-02	2.776e-02	2.828e-02	2.844e-02	2.849e-02	2.849e-02	2.849e-02	2.849e-02	2.849e-02	2.849e-02
RU	0.000e+00	1.153e-01	1.132e-01	1.115e-01	1.084e-01	1.057e-01	1.036e-01	1.019e-01	1.002e-01	9.86e-02	9.71e-02	9.57e-02
RM	0.000e+00	6.590e-03	1.058e-02	1.358e-02	1.909e-02	2.205e-02	2.378e-02	2.489e-02	2.568e-02	2.623e-02	2.666e-02	2.703e-02
PD	0.000e+00	3.121e-02	3.402e-02	3.595e-02	4.008e-02	4.303e-02	4.548e-02	4.751e-02	4.929e-02	5.086e-02	5.224e-02	5.355e-02
AC	0.000e+00	4.250e-03	4.258e-03	4.392e-03	4.788e-03	5.060e-03	5.274e-03	5.439e-03	5.574e-03	5.684e-03	5.774e-03	5.859e-03
CD	0.000e+00	8.295e-03	8.242e-03	8.083e-03	7.688e-03	7.426e-03	7.211e-03	7.050e-03	6.920e-03	6.817e-03	6.740e-03	6.686e-03
IM	0.000e+00	1.294e-03	1.333e-03	1.350e-03	1.228e-03	1.138e-03	1.061e-03	1.001e-03	9.493e-04	9.068e-04	8.721e-04	8.380e-04
SN	0.000e+00	1.187e-02	1.106e-02	1.035e-02	9.592e-03	9.029e-03	8.598e-03	8.276e-03	8.016e-03	7.806e-03	7.641e-03	7.482e-03
SB	0.000e+00	5.256e-03	4.782e-03	4.520e-03	4.075e-03	3.793e-03	3.571e-03	3.356e-03	3.248e-03	3.123e-03	3.015e-03	2.914e-03
TE	0.000e+00	1.703e-02	1.431e-02	1.298e-02	1.861e-02	1.813e-02	1.788e-02	1.770e-02	1.758e-02	1.751e-02	1.745e-02	1.741e-02
I	0.000e+00	1.630e-01	1.075e-01	1.088e-01	1.103e-01	1.111e-01	1.116e-01	1.119e-01	1.122e-01	1.125e-01	1.126e-01	1.128e-01
XE	0.000e+00	8.078e-02	8.844e-02	8.927e-02	9.193e-02	9.321e-02	9.397e-02	9.445e-02	9.475e-02	9.502e-02	9.518e-02	9.531e-02
CS	0.000e+00	4.200e-02	5.999e-02	3.472e-02	3.264e-02	3.201e-02	3.185e-02	3.164e-02	3.130e-02	3.199e-02	3.211e-02	3.225e-02
BA	0.000e+00	3.054e-02	2.976e-02	2.938e-02	2.898e-02	2.883e-02	2.876e-02	2.871e-02	2.868e-02	2.868e-02	2.864e-02	2.862e-02
LA	0.000e+00	7.200e-02	7.240e-02	7.400e-02	7.169e-02	6.873e-02	6.659e-02	6.492e-02	6.376e-02	6.244e-02	6.148e-02	6.054e-02
CE	0.000e+00	1.761e-02	1.778e-02	1.876e-02	2.138e-02	2.280e-02	2.361e-02	2.413e-02	2.448e-02	2.473e-02	2.492e-02	2.509e-02
PR	0.000e+00	6.463e-02	6.754e-02	6.920e-02	7.156e-02	7.314e-02	7.433e-02	7.523e-02	7.617e-02	7.691e-02	7.755e-02	7.818e-02
AD	0.000e+00	7.250e-03	6.853e-03	6.416e-03	5.542e-03	9.262e-03	8.896e-03	8.531e-03	8.184e-03	7.860e-03	7.558e-03	7.240e-03
PM	0.000e+00	1.419e-02	1.484e-02	1.524e-02	1.602e-02	1.662e-02	1.715e-02	1.756e-02	1.795e-02	1.831e-02	1.863e-02	1.897e-02
SM	0.000e+00	2.582e-03	2.641e-03	2.681e-03	2.696e-03	2.716e-03	2.730e-03	2.738e-03	2.744e-03	2.747e-03	2.749e-03	2.749e-03
EU	0.000e+00	6.414e-04	7.919e-04	8.921e-04	1.065e-03	1.173e-03	1.255e-03	1.321e-03	1.377e-03	1.428e-03	1.470e-03	1.515e-03
CD	0.000e+00	9.596e-01	9.996e-01	9.996e-01	9.996e-01	9.996e-01	9.996e-01	9.996e-01	9.996e-01	9.996e-01	9.996e-01	9.996e-01
SURTOT	0.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00
TOTAL	0.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00

Command File and Output Data

```
-1
-1
-1
BAS ONE METRIC TON OF LMFBR FUEL (Radial Blanket)
LIP 0 0 0
LIB 0 0 2 3 317 31E 319 5 3 0 1 14
PHO 0 0 0 10
OPTL 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8
OPTA 8 8 8 7 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8
OPTF 8 8 8 7 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8
IMP -1 1 -1 -1 1 1
MOV -1 1 0 1.0
BUP
IRP 30 3.59 1 2 4 2
IRP 90 3.59 2 3 4 0
IRP 180 3.59 3 4 4 0
IRP 360 3.59 4 5 4 0
IRP 540 3.59 5 6 4 0
IRP 720 3.59 6 7 4 0
IRP 900 3.59 7 8 4 0
IRP 1080 3.59 8 9 4 0
IRP 1260 3.59 9 10 4 0
IRP 1440 3.59 10 11 4 0
IRP 1644 3.59 11 12 4 0
BUP
TIT * IRRADIATION OF ONE METRIC TON OF LMFBR FUEL (Radial Blanket) *
DLT -12 1 -1 0
END
2 922350 2000.0 922380 998000.0 0 0.0
4 030000 1.0 05000C 1.0 060000 89.4 070000 25.0 FUEL IMPUR
4 C800000 134454.0 09000C 10.7 110000 15.0 120000 2.0 FUEL IMPUR
4 130000 16.7 14000C 12.1 150000 35.0 170000 5.3 FUEL IMPUR
4 200000 2.0 22000C 1.0 230000 3.0 240000 4.0 FUEL IMPUR
4 250000 1.7 26000C 18.0 270000 1.0 280000 24.0 FUEL IMPUR
4 290000 1.0 30000C 40.3 420000 10.0 470000 0.1 FUEL IMPUR
4 480000 25.0 49000C 2.0 500000 4.0 640000 2.5 FUEL IMPUR
4 740000 2.0 82000C 1.0 830000 0.4 0 0.0 FUEL IMPUR
0
```

* IRRADIATION OF ONE METRIC TON OF LMFBR FUEL (Radial Blanket) *
 POWER= 3.59000e+00 MW, BURRUP= 5.90196e+03 MW, FLUX= 6.72e+14 N/CM^2-SEC
 REACTIVITY AND BURNUP DATA
 BASIS= METRIC TON OF LMFBR FUEL (Radial Blanket)

	0.5	30.0D	90.0D	180.0D	360.0D	540.0D	720.0D	900.0D	1080.0D	1260.0D	1440.0D	1644.0D
TIME, SEC	0.00e+00	2.55e+06	7.78e+06	1.56e+07	3.11e+07	4.67e+07	6.22e+07	7.78e+07	9.33e+07	1.09e+08	1.24e+08	1.42e+08
NEUT. FLUX	0.00e+00	2.19e+15	1.48e+15	1.11e+15	8.62e+14	7.00e+14	6.25e+14	5.56e+14	5.15e+14	4.90e+14	4.69e+14	4.51e+14
SP POW, MW	0.00e+00	3.59e+00	3.59e+00	3.59e+00	3.59e+00	3.59e+00	3.59e+00	3.59e+00	3.59e+00	3.59e+00	3.59e+00	3.59e+00
BURRUP, MW	0.00e+00	1.08e+02	2.15e+02	3.23e+02	4.46e+02	6.46e+02	6.46e+02	6.46e+02	6.46e+02	6.46e+02	6.46e+02	7.32e+02
K INFINITY	0.	C.20798	0.26936	C.31929	0.38432	0.44280	0.47720	0.52194	0.55584	0.57149	0.59700	C.61707
NEUT PRODN	0.00e+00	2.78e+02	3.29e+02	3.79e+02	4.51e+02	5.03e+02	5.48e+02	5.84e+02	6.16e+02	6.45e+02	6.73e+02	7.02e+02
NEUT DESTN	0.00e+00	1.34e+03	1.22e+03	1.19e+03	1.17e+03	1.14e+03	1.15e+03	1.12e+03	1.11e+03	1.12e+03	1.13e+03	1.14e+03
TOT BURRUP	0.00e+00	5.90e+03	5.90e+03	5.90e+03	5.90e+03	5.90e+03	5.90e+03	5.90e+03	5.90e+03	5.90e+03	5.90e+03	5.90e+03
AVG N FLUX	0.00e+00	6.72e+14	6.72e+14	6.72e+14	6.72e+14	6.72e+14	6.72e+14	6.72e+14	6.72e+14	6.72e+14	6.72e+14	6.72e+14
AVG SP POW	0.00e+00	3.59e+00	3.59e+00	3.59e+00	3.59e+00	3.59e+00	3.59e+00	3.59e+00	3.59e+00	3.59e+00	3.59e+00	3.59e+00

SIZE OF MMAX(I): PMAX= 1 0= 565 MMAX= 2 0= 255 PMAX= 3 0= 69 MMAX= 4 0= 21 PMAX= 5 0= 26 PMAX= 6 0= 41
 PPAR= 7 0= 25 PPAR= 8 0= 0 MMAX= 9 0= 0 MMAX= 10 0= 0 MMAX= 11 0= 0 MMAX= 12 0= 0

THE NUMBER OF MCN-ZERO TERMS IN A=4932
 THE NUMBER OF MCN-ZERO FISSION PRODUCT YIELDS=3242
 ILITE= 0 IACT= 125 IFF= 875 ITCT=1008
 THE NUMBER OF MCN-ZERO NATURAL ABUNDANCES= 154
 THE NUMBER OF MCN-ZERO FICTON YIELDS= 0
 THE MAXIMUM NUMBER OF TERPS IN AP= 2209

* IRRADIATION OF ONE METRIC TON OF LMFBR FUEL (Radial Blanket) *

POWER= 3.59C00e+00 MW, BURNUP= 5.90196e+03 MWD, FLUX= 6.72e+14 N/CM^2-SEC
 & SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS
 METRIC TON OF LMFBR FUEL (Radial Blanket)

ACTINIDES+CAUGHTERS

	0. S	3C.00	9C.00	180.00	360.00	540.00	720.00	900.00	1080.00	1260.00	1440.00	1644.00
U235	2.025e-03	1.572e-03	1.914e-03	1.855e-03	1.771e-03	1.711e-03	1.660e-03	1.618e-03	1.581e-03	1.547e-03	1.516e-03	1.482e-03
U238	9.980e-01	9.552e-01	9.919e-01	9.885e-01	9.837e-01	9.801e-01	9.769e-01	9.740e-01	9.721e-01	9.700e-01	9.680e-01	9.659e-01
PU239	0.000e+00	2.472e-03	5.860e-03	9.248e-03	1.499e-02	1.760e-02	2.059e-02	2.305e-02	2.519e-02	2.718e-02	2.903e-02	3.100e-02
PU240	0.000e+00	1.251e-05	5.293e-05	1.228e-04	2.731e-04	4.183e-04	5.704e-04	7.106e-04	8.461e-04	9.843e-04	1.125e-03	1.267e-03
SUMTDT	1.000e+00	9.597e-01	5.998e-01	9.998e-01	5.998e-01	9.998e-01	9.998e-01	9.998e-01	9.997e-01	9.997e-01	9.997e-01	9.997e-01
TOTAL	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00

* IRRADIATION OF ONE METRIC TON OF LMFBR FUEL (Radial Blanket) *

POWER= 3.59C00e+00 MW, BURNUP= 5.90196e+03 MWD, FLUX= 6.72e+14 N/CM^2-SEC
 & SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS
 METRIC TON OF LMFBR FUEL (Radial Blanket)

ACTINIDES+CAUGHTERS

	0. S	3C.00	9C.00	180.00	360.00	540.00	720.00	900.00	1080.00	1260.00	1440.00	1644.00
U	1.000e+00	9.572e-01	5.939e-01	9.905e-01	9.955e-01	9.819e-01	9.787e-01	9.761e-01	9.738e-01	9.717e-01	9.697e-01	9.675e-01
PU	0.000e+00	2.484e-03	5.913e-03	9.293e-03	1.436e-02	1.803e-02	2.118e-02	2.378e-02	2.606e-02	2.819e-02	3.019e-02	3.233e-02
SUMTCT	1.000e+00	9.597e-01	5.998e-01	9.998e-01	5.999e-01	9.999e-01	9.999e-01	9.999e-01	9.995e-01	9.995e-01	9.995e-01	9.995e-01
TOTAL	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00

FISSION PRODUCTS

* IRRADIATION OF ONE METRIC TON OF LPPOR FUEL (Radial Blanket) *

POWER= 3.59000e+00 MW, BURNUP= 5.90194e+03 MWd, FLUX= 6.72e+16 N/CM^2-SEC

4 SUPPLY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS

METRIC TON OF LPPOR FUEL (Radial Blanket)

	C. 5	30.00	90.00	180.00	360.00	540.00	720.00	900.00	1080.00	1260.00	1440.00	1644.00
OR 81	0.000e+00	1.013e-03	9.331e-04	8.812e-04	8.307e-04	8.065e-04	7.876e-04	7.766e-04	7.683e-04	7.604e-04	7.529e-04	7.449e-04
SE 82	0.000e+00	1.505e-03	1.404e-03	1.338e-03	1.274e-03	1.245e-03	1.221e-03	1.209e-03	1.200e-03	1.191e-03	1.182e-03	1.173e-03
OR 83	0.000e+00	2.475e-03	2.367e-03	2.289e-03	2.211e-03	2.171e-03	2.141e-03	2.121e-03	2.106e-03	2.092e-03	2.079e-03	2.065e-03
OR 84	0.000e+00	4.370e-03	4.093e-03	3.926e-03	3.771e-03	3.700e-03	3.649e-03	3.619e-03	3.598e-03	3.580e-03	3.563e-03	3.545e-03
OR 85	0.000e+00	1.007e-03	5.362e-04	8.899e-04	8.414e-04	8.118e-04	7.882e-04	7.692e-04	7.524e-04	7.371e-04	7.225e-04	7.088e-04
OR 86	0.000e+00	3.477e-03	3.429e-03	3.155e-03	3.097e-03	3.060e-03	3.029e-03	3.026e-03	3.026e-03	3.016e-03	3.008e-03	3.001e-03
OR 87	0.000e+00	7.208e-03	6.511e-03	6.267e-03	5.937e-03	5.806e-03	5.702e-03	5.635e-03	5.585e-03	5.543e-03	5.506e-03	5.480e-03
OR 88	0.000e+00	9.016e-03	8.293e-03	7.873e-03	7.493e-03	7.309e-03	7.181e-03	7.098e-03	7.037e-03	6.984e-03	6.938e-03	6.892e-03
OR 89	0.000e+00	1.278e-02	1.164e-02	1.096e-02	1.034e-02	1.003e-02	9.822e-03	9.688e-03	9.580e-03	9.503e-03	9.428e-03	9.353e-03
OR 90	0.000e+00	2.833e-03	2.322e-03	2.087e-03	1.887e-03	1.710e-03	1.558e-03	1.428e-03	1.316e-03	1.210e-03	1.112e-03	1.022e-03
OR 91	0.000e+00	1.658e-02	1.485e-02	1.358e-02	1.258e-02	1.180e-02	1.128e-02	1.092e-02	1.067e-02	1.042e-02	1.017e-02	1.000e-02
OR 92	0.000e+00	1.721e-02	1.160e-02	7.283e-03	3.862e-03	2.516e-03	1.842e-03	1.463e-03	1.211e-03	1.029e-03	8.921e-04	7.757e-04
OR 93	0.000e+00	3.125e-03	1.763e-03	1.077e-03	1.333e-03	1.429e-03	1.463e-03	1.482e-03	1.492e-03	1.498e-03	1.501e-03	1.501e-03
OR 94	0.000e+00	2.216e-02	2.084e-02	2.003e-02	1.930e-02	1.893e-02	1.868e-02	1.853e-02	1.841e-02	1.831e-02	1.822e-02	1.813e-02
OR 95	0.000e+00	2.501e-02	2.407e-02	2.339e-02	2.273e-02	2.240e-02	2.217e-02	2.201e-02	2.190e-02	2.180e-02	2.171e-02	2.162e-02
OR 96	0.000e+00	2.584e-02	2.297e-02	2.233e-02	2.166e-02	2.158e-02	2.187e-02	2.179e-02	2.173e-02	2.169e-02	2.166e-02	2.163e-02
OR 97	0.000e+00	3.562e-03	1.714e-02	1.152e-02	6.526e-03	4.354e-03	3.241e-03	2.582e-03	2.146e-03	1.833e-03	1.600e-03	1.400e-03
OR 98	0.000e+00	3.178e-03	5.482e-03	5.268e-03	5.427e-03	5.359e-03	5.176e-03	5.105e-03	5.172e-03	5.102e-03	5.029e-03	4.950e-03
OR 99	0.000e+00	6.346e-04	4.004e-03	9.360e-03	1.574e-02	1.874e-02	2.027e-02	2.116e-02	2.174e-02	2.213e-02	2.241e-02	2.260e-02
OR 100	0.000e+00	2.721e-02	2.664e-02	2.632e-02	2.604e-02	2.589e-02	2.579e-02	2.572e-02	2.567e-02	2.563e-02	2.559e-02	2.555e-02
OR 101	0.000e+00	1.671e-03	3.377e-04	1.618e-04	6.125e-05	5.208e-05	3.853e-05	3.050e-05	2.528e-05	2.100e-05	1.885e-05	1.722e-05
OR 102	0.000e+00	2.640e-02	2.677e-02	2.672e-02	2.672e-02	2.651e-02	2.644e-02	2.638e-02	2.634e-02	2.630e-02	2.626e-02	2.622e-02
OR 103	0.000e+00	2.414e-02	2.408e-02	2.407e-02	2.407e-02	2.407e-02	2.407e-02	2.407e-02	2.407e-02	2.407e-02	2.407e-02	2.407e-02
OR 104	0.000e+00	4.452e-03	1.837e-02	1.807e-02	1.808e-02	1.809e-02	1.811e-02	1.813e-02	1.814e-02	1.816e-02	1.817e-02	1.819e-02
OR 105	0.000e+00	2.464e-02	2.767e-02	2.835e-02	2.860e-02	2.866e-02	2.866e-02	2.865e-02	2.863e-02	2.860e-02	2.857e-02	2.855e-02
OR 106	0.000e+00	3.531e-02	3.055e-02	3.055e-02	3.055e-02	3.055e-02	3.055e-02	3.055e-02	3.055e-02	3.055e-02	3.055e-02	3.055e-02
OR 107	0.000e+00	2.546e-02	3.000e-02	3.031e-02	3.031e-02	3.031e-02	3.031e-02	3.031e-02	3.031e-02	3.031e-02	3.031e-02	3.031e-02
OR 108	0.000e+00	2.643e-02	2.958e-02	3.025e-02	3.084e-02	3.120e-02	3.143e-02	3.160e-02	3.174e-02	3.186e-02	3.196e-02	3.207e-02
OR 109	0.000e+00	1.541e-02	1.380e-02	1.731e-03	4.844e-03	3.231e-03	2.433e-03	1.950e-03	1.622e-03	1.401e-03	1.223e-03	1.086e-03
OR 110	0.000e+00	5.071e-02	1.253e-02	1.862e-02	2.336e-02	2.534e-02	2.702e-02	2.836e-02	2.938e-02	3.016e-02	3.076e-02	3.126e-02
OR 111	0.000e+00	2.138e-02	2.367e-02	2.496e-02	2.610e-02	2.665e-02	2.702e-02	2.726e-02	2.743e-02	2.757e-02	2.769e-02	2.781e-02
OR 112	0.000e+00	1.094e-02	1.094e-02	1.094e-02	1.094e-02	1.094e-02	1.094e-02	1.094e-02	1.094e-02	1.094e-02	1.094e-02	1.094e-02
OR 113	0.000e+00	1.412e-03	5.182e-04	2.639e-04	1.331e-04	9.074e-05	6.823e-05	5.422e-05	4.518e-05	3.900e-05	3.419e-05	3.010e-05
OR 114	0.000e+00	1.436e-02	1.726e-02	1.862e-02	1.965e-02	2.048e-02	2.077e-02	2.077e-02	2.080e-02	2.080e-02	2.079e-02	2.078e-02
OR 115	0.000e+00	1.045e-02	1.231e-02	1.247e-02	1.162e-02	1.043e-02	9.353e-03	8.359e-03	7.501e-03	6.779e-03	6.168e-03	5.568e-03
OR 116	0.000e+00	3.534e-04	1.135e-03	2.293e-03	4.406e-03	6.333e-03	7.784e-03	9.031e-03	1.019e-02	1.113e-02	1.194e-02	1.273e-02
OR 117	0.000e+00	6.522e-03	5.396e-03	9.273e-03	1.007e-02	1.045e-02	1.071e-02	1.087e-02	1.098e-02	1.108e-02	1.117e-02	1.126e-02
OR 118	0.000e+00	4.648e-03	5.765e-03	6.452e-03	7.104e-03	7.426e-03	7.665e-03	7.814e-03	7.928e-03	8.032e-03	8.127e-03	8.226e-03
OR 119	0.000e+00	3.339e-03	4.209e-03	4.709e-03	5.158e-03	5.348e-03	5.517e-03	5.640e-03	5.667e-03	5.722e-03	5.771e-03	5.821e-03
OR 120	0.000e+00	2.157e-03	2.444e-03	2.600e-03	2.734e-03	2.801e-03	2.844e-03	2.873e-03	2.895e-03	2.912e-03	2.926e-03	2.939e-03
OR 121	0.000e+00	1.111e-03	1.613e-03	1.795e-03	1.892e-03	1.934e-03	1.951e-03	1.966e-03	1.977e-03	1.984e-03	1.987e-03	1.989e-03
OR 122	0.000e+00	1.405e-03	1.490e-03	1.502e-03	1.495e-03	1.498e-03	1.492e-03	1.495e-03	1.495e-03	1.498e-03	1.496e-03	1.493e-03
OR 123	0.000e+00	1.304e-03	1.313e-03	1.293e-03	1.259e-03	1.248e-03	1.231e-03	1.227e-03	1.224e-03	1.219e-03	1.212e-03	1.203e-03
OR 124	0.000e+00	1.090e-03	1.080e-03	1.057e-03	1.025e-03	1.015e-03	1.004e-03	9.910e-04	9.765e-04	9.595e-04	9.408e-04	9.218e-04
OR 125	0.000e+00	9.850e-04	1.059e-03	1.044e-03	9.946e-04	9.596e-04	9.238e-04	8.854e-04	8.450e-04	8.040e-04	7.624e-04	7.204e-04
OR 126	0.000e+00	1.056e-03	9.814e-04	9.464e-04	9.038e-04	8.675e-04	8.290e-04	7.895e-04	7.581e-04	7.247e-04	6.904e-04	6.557e-04
OR 127	0.000e+00	1.018e-03	9.728e-04	9.638e-04	9.214e-04	8.851e-04	8.456e-04	8.010e-04	7.580e-04	7.168e-04	6.776e-04	6.404e-04
OR 128	0.000e+00	1.076e-03	1.048e-03	1.042e-03	1.042e-03	1.042e-03	1.042e-03	1.042e-03	1.042e-03	1.042e-03	1.042e-03	1.042e-03
OR 129	0.000e+00	1.306e-03	1.306e-03	1.270e-03	1.224e-03	1.207e-03	1.187e-03	1.161e-03	1.136e-03	1.110e-03	1.084e-03	1.058e-03
OR 130	0.000e+00	1.380e-03	1.380e-03	1.380e-03	1.380e-03	1.380e-03	1.380e-03	1.380e-03	1.380e-03	1.380e-03	1.380e-03	1.380e-03
OR 131	0.000e+00	1.553e-03	1.553e-03	1.553e-03	1.553e-03	1.553e-03	1.553e-03	1.553e-03	1.553e-03	1.553e-03	1.553e-03	1.553e-03
OR 132	0.000e+00	1.553e-03	1.553e-03	1.553e-03	1.553e-03	1.553e-03	1.553e-03	1.553e-03	1.553e-03	1.553e-03	1.553e-03	1.553e-03

OUTPUT UNIT = 11

FISSION PRODUCTS

* IRRADIATION OF ONE METRIC TON OF LPFB FUEL (Radial Blanket) *

POWER= 3.590000e+00 MW, BURAP= 5.90196e+03 MWD, FLUX= 6.72e+14 N/CM2-SEC

* SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS

METRIC TON OF LPFB FUEL (Radial Blanket)

	0. S	30.00	90.00	180.00	360.00	540.00	720.00	900.00	1080.00	1260.00	1440.00	1644.00
I127	0.000e+00	2.148e-03	2.642e-03	2.923e-03	2.943e-03	3.002e-03	3.023e-03	3.040e-03	3.050e-03	3.053e-03	3.051e-03	3.046e-03
TE128	0.000e+00	4.696e-03	4.927e-03	4.909e-03	4.873e-03	4.863e-03	4.843e-03	4.840e-03	4.837e-03	4.831e-03	4.823e-03	4.812e-03
I128	0.000e+00	6.147e-03	6.623e-03	6.894e-03	7.068e-03	7.139e-03	7.166e-03	7.165e-03	7.196e-03	7.200e-03	7.200e-03	7.196e-03
TE130	0.000e+00	1.136e-02	1.157e-02	1.167e-02	1.173e-02	1.179e-02	1.181e-02	1.183e-02	1.185e-02	1.186e-02	1.186e-02	1.187e-02
I131	0.000e+00	6.494e-03	2.535e-03	1.299e-03	6.613e-04	4.257e-04	3.164e-04	2.505e-04	2.079e-04	1.780e-04	1.556e-04	1.366e-04
TE131	0.000e+00	1.648e-02	1.539e-02	1.703e-02	1.787e-02	1.817e-02	1.832e-02	1.840e-02	1.845e-02	1.848e-02	1.850e-02	1.852e-02
TE132	0.000e+00	4.225e-03	1.448e-03	7.029e-04	3.567e-04	2.933e-04	1.702e-04	1.348e-04	1.118e-04	9.564e-05	8.358e-05	7.230e-05
TE132	0.000e+00	2.120e-02	2.357e-02	2.455e-02	2.510e-02	2.533e-02	2.547e-02	2.556e-02	2.562e-02	2.568e-02	2.573e-02	2.578e-02
I133	0.000e+00	1.965e-03	5.045e-04	2.438e-04	1.234e-04	7.920e-05	5.875e-05	4.647e-05	3.853e-05	3.296e-05	2.880e-05	2.525e-05
TE133	0.000e+00	8.284e-03	2.070e-03	1.484e-03	7.521e-04	4.829e-04	3.585e-04	2.826e-04	2.352e-04	2.013e-04	1.760e-04	1.544e-04
CS133	0.000e+00	2.225e-02	2.902e-02	3.084e-02	3.160e-02	3.181e-02	3.188e-02	3.189e-02	3.187e-02	3.184e-02	3.181e-02	3.177e-02
TE134	0.000e+00	3.577e-02	2.569e-02	3.565e-02	3.562e-02	3.560e-02	3.559e-02	3.557e-02	3.556e-02	3.555e-02	3.555e-02	3.555e-02
CS135	0.000e+00	3.675e-02	3.211e-02	3.270e-02	3.318e-02	3.339e-02	3.355e-02	3.363e-02	3.369e-02	3.374e-02	3.379e-02	3.384e-02
TE136	0.000e+00	3.128e-02	3.633e-02	3.187e-02	3.211e-02	3.222e-02	3.231e-02	3.238e-02	3.240e-02	3.243e-02	3.246e-02	3.250e-02
CS137	0.000e+00	2.680e-02	2.907e-02	2.918e-02	2.924e-02	2.914e-02	2.905e-02	2.894e-02	2.879e-02	2.865e-02	2.852e-02	2.837e-02
BA137	0.000e+00	3.002e-05	5.986e-05	1.704e-04	2.371e-04	5.043e-04	6.706e-04	8.355e-04	9.991e-04	1.161e-03	1.323e-03	1.504e-03
BA138	0.000e+00	2.576e-02	2.974e-02	2.980e-02	2.980e-02	2.990e-02	2.994e-02	2.995e-02	2.995e-02	2.997e-02	2.998e-02	3.000e-02
BA139	0.000e+00	2.508e-02	2.890e-02	2.879e-02	2.870e-02	2.864e-02	2.861e-02	2.859e-02	2.857e-02	2.855e-02	2.854e-02	2.852e-02
LA140	0.000e+00	1.287e-02	5.706e-03	2.830e-03	1.472e-03	9.418e-04	6.976e-04	5.512e-04	4.566e-04	3.503e-04	2.405e-04	2.588e-04
LA140	0.000e+00	1.621e-03	7.529e-04	3.722e-04	1.935e-04	1.239e-04	9.182e-05	7.257e-05	6.013e-05	5.143e-05	4.494e-05	3.940e-05
CE141	0.000e+00	1.261e-02	1.132e-02	2.428e-02	2.545e-02	2.579e-02	2.604e-02	2.614e-02	2.619e-02	2.622e-02	2.625e-02	2.628e-02
CE141	0.000e+00	1.571e-02	1.195e-02	6.835e-03	1.583e-03	2.340e-03	1.748e-03	1.387e-03	1.132e-03	9.861e-04	8.650e-04	7.598e-04
PR141	0.000e+00	6.483e-03	1.422e-02	1.538e-02	2.264e-02	2.386e-02	2.445e-02	2.479e-02	2.500e-02	2.515e-02	2.526e-02	2.536e-02
CE142	0.000e+00	2.481e-02	2.457e-02	2.443e-02	2.432e-02	2.425e-02	2.421e-02	2.418e-02	2.416e-02	2.414e-02	2.413e-02	2.411e-02
CE143	0.000e+00	1.617e-03	5.645e-04	2.646e-04	1.343e-04	8.573e-05	6.339e-05	5.605e-05	4.144e-05	3.540e-05	3.090e-05	2.707e-05
PR143	0.000e+00	1.181e-02	5.033e-03	2.507e-03	1.324e-03	8.432e-04	6.250e-04	4.936e-04	4.086e-04	3.491e-04	3.047e-04	2.669e-04
MO143	0.000e+00	1.644e-02	1.776e-02	2.019e-02	2.125e-02	2.197e-02	2.167e-02	2.170e-02	2.170e-02	2.169e-02	2.167e-02	2.164e-02
CE144	0.000e+00	2.118e-02	1.897e-02	1.669e-02	1.343e-02	1.107e-02	9.295e-03	7.940e-03	6.801e-03	6.036e-03	5.354e-03	4.730e-03
MO144	0.000e+00	7.534e-04	2.214e-03	4.076e-03	6.984e-03	9.187e-03	1.087e-02	1.217e-02	1.315e-02	1.400e-02	1.466e-02	1.527e-02
MO145	0.000e+00	1.735e-02	1.712e-02	1.688e-02	1.663e-02	1.649e-02	1.639e-02	1.624e-02	1.626e-02	1.621e-02	1.616e-02	1.611e-02
MO146	0.000e+00	1.477e-02	1.458e-02	1.445e-02	1.433e-02	1.429e-02	1.425e-02	1.425e-02	1.425e-02	1.425e-02	1.425e-02	1.424e-02
NC147	0.000e+00	5.420e-03	2.116e-03	1.638e-03	5.341e-04	3.432e-04	2.534e-04	2.013e-04	1.670e-04	1.424e-04	1.243e-04	1.080e-04
PM147	0.000e+00	5.597e-03	8.810e-03	9.302e-03	8.903e-03	8.352e-03	7.794e-03	7.293e-03	6.841e-03	6.424e-03	6.042e-03	5.649e-03
SM147	0.000e+00	4.775e-05	2.462e-04	5.690e-04	1.189e-03	1.730e-03	2.209e-03	2.636e-03	3.020e-03	3.367e-03	3.680e-03	3.956e-03
MO148	0.000e+00	9.292e-03	5.283e-03	9.247e-03	9.194e-03	9.170e-03	9.143e-03	9.130e-03	9.120e-03	9.107e-03	9.093e-03	9.077e-03
SM148	0.000e+00	1.643e-05	1.239e-04	2.831e-04	5.444e-04	7.330e-04	8.816e-04	9.589e-04	1.038e-03	1.186e-03	1.268e-03	1.346e-03
SM149	0.000e+00	6.004e-03	6.597e-03	6.710e-03	6.866e-03	6.960e-03	7.008e-03	7.036e-03	7.052e-03	7.058e-03	7.062e-03	7.064e-03
MO150	0.000e+00	5.007e-03	5.467e-03	5.234e-03	5.277e-03	5.302e-03	5.308e-03	5.317e-03	5.324e-03	5.326e-03	5.326e-03	5.326e-03
SM151	0.000e+00	3.255e-03	2.568e-03	3.635e-03	3.655e-03	3.650e-03	3.625e-03	3.601e-03	3.575e-03	3.547e-03	3.518e-03	3.485e-03
SM152	0.000e+00	2.437e-03	2.673e-03	2.827e-03	2.990e-03	3.088e-03	3.165e-03	3.224e-03	3.274e-03	3.319e-03	3.361e-03	3.405e-03
EU153	0.000e+00	1.495e-03	1.700e-03	1.770e-03	1.807e-03	1.819e-03	1.820e-03	1.819e-03	1.816e-03	1.812e-03	1.807e-03	1.805e-03
SM154	0.000e+00	9.621e-04	1.102e-03	1.170e-03	1.230e-03	1.259e-03	1.259e-03	1.259e-03	1.259e-03	1.259e-03	1.259e-03	1.259e-03
SUMTCT	0.000e+00	9.618e-01	5.870e-01	9.882e-01	9.884e-01	9.881e-01	9.877e-01	9.873e-01	9.869e-01	9.865e-01	9.861e-01	9.856e-01
TCTAL	0.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00

FISSION PRODUCTS

* IRRADIATION OF ONE METRIC TON OF LMFBR FUEL (Radio Blanket) *

POWER= 3.59000e+00 MW. BURNUP= 5.90196e+03 MWD. FLUX= 6.72e+14 N/CM^2-SEC

4. SUMMARY TABLE: CONCENTRATIONS, FRACTIONAL GRAM-ATOMS

METRIC TON OF LMFBR FUEL (Radio Blanket)

	G. S	30.00	90.00	180.00	360.00	540.00	720.00	900.00	1080.00	1260.00	1440.00	1644.00
SE	0.000e+00	2.640e-03	2.467e-03	2.355e-03	2.248e-03	2.199e-03	2.160e-03	2.139e-03	2.123e-03	2.108e-03	2.094e-03	2.080e-03
BR	0.000e+00	1.033e-03	5.391e-04	8.840e-04	8.321e-04	8.074e-04	7.883e-04	7.719e-04	7.587e-04	7.467e-04	7.352e-04	7.242e-04
KR	0.000e+00	1.123e-02	1.406e-02	1.340e-02	1.280e-02	1.231e-02	1.230e-02	1.217e-02	1.206e-02	1.197e-02	1.185e-02	1.181e-02
RB	0.000e+00	1.172e-02	1.173e-02	1.116e-02	1.065e-02	1.014e-02	1.024e-02	1.016e-02	1.006e-02	1.000e-02	9.948e-03	9.895e-03
SR	0.000e+00	4.536e-02	3.708e-02	3.187e-02	2.781e-02	2.607e-02	2.504e-02	2.439e-02	2.391e-02	2.351e-02	2.316e-02	2.283e-02
Y	0.000e+00	2.086e-02	1.818e-02	1.629e-02	1.449e-02	1.365e-02	1.315e-02	1.285e-02	1.264e-02	1.247e-02	1.233e-02	1.219e-02
ZR	0.000e+00	1.611e-01	1.195e-01	1.149e-01	1.104e-01	1.082e-01	1.068e-01	1.059e-01	1.053e-01	1.049e-01	1.045e-01	1.041e-01
NB	0.000e+00	3.570e-03	5.515e-03	5.285e-03	5.436e-03	5.350e-03	5.176e-03	5.142e-03	5.175e-03	5.105e-03	5.072e-03	5.049e-03
PO	0.000e+00	9.000e-02	5.087e-02	9.563e-02	1.018e-01	1.047e-01	1.062e-01	1.071e-01	1.077e-01	1.081e-01	1.084e-01	1.086e-01
YC	0.000e+00	2.504e-02	2.780e-02	2.641e-02	2.863e-02	2.868e-02	2.868e-02	2.868e-02	2.864e-02	2.861e-02	2.857e-02	2.854e-02
RU	0.000e+00	1.097e-01	1.095e-01	1.095e-01	1.043e-01	1.025e-01	1.014e-01	1.004e-01	9.956e-02	9.852e-02	9.741e-02	9.795e-02
PM	0.000e+00	6.209e-03	1.307e-02	1.889e-02	2.350e-02	2.544e-02	2.643e-02	2.703e-02	2.742e-02	2.770e-02	2.790e-02	2.808e-02
PD	0.000e+00	2.868e-02	2.514e-02	3.943e-02	4.433e-02	4.757e-02	5.010e-02	5.204e-02	5.363e-02	5.499e-02	5.617e-02	5.724e-02
AG	0.000e+00	3.591e-03	4.488e-03	4.946e-03	5.233e-03	5.422e-03	5.560e-03	5.641e-03	5.699e-03	5.751e-03	5.798e-03	5.845e-03
CC	0.000e+00	6.174e-03	6.222e-03	6.704e-03	6.683e-03	6.706e-03	6.683e-03	6.704e-03	6.726e-03	6.736e-03	6.732e-03	6.725e-03
IM	0.000e+00	1.000e-03	1.064e-03	1.047e-03	9.930e-04	9.611e-04	9.249e-04	9.044e-04	8.872e-04	8.680e-04	8.480e-04	8.259e-04
SN	0.000e+00	9.524e-03	8.577e-03	8.284e-03	7.966e-03	7.855e-03	7.732e-03	7.700e-03	7.683e-03	7.652e-03	7.614e-03	7.567e-03
SB	0.000e+00	4.059e-03	2.722e-03	3.542e-03	3.336e-03	3.222e-03	3.101e-03	3.021e-03	2.951e-03	2.878e-03	2.805e-03	2.726e-03
TE	0.000e+00	2.188e-02	1.892e-02	1.800e-02	1.755e-02	1.744e-02	1.740e-02	1.742e-02	1.745e-02	1.748e-02	1.751e-02	1.754e-02
I	0.000e+00	1.722e-02	1.253e-02	1.137e-02	1.083e-02	1.068e-02	1.059e-02	1.054e-02	1.051e-02	1.048e-02	1.045e-02	1.042e-02
XE	0.000e+00	1.072e-01	1.097e-01	1.108e-01	1.116e-01	1.120e-01	1.122e-01	1.124e-01	1.125e-01	1.126e-01	1.127e-01	1.128e-01
CS	0.000e+00	9.113e-02	9.042e-02	9.300e-02	9.437e-02	9.478e-02	9.497e-02	9.497e-02	9.485e-02	9.481e-02	9.471e-02	9.459e-02
BA	0.000e+00	4.586e-02	2.580e-02	3.314e-02	3.214e-02	3.190e-02	3.193e-02	3.264e-02	3.219e-02	3.237e-02	3.257e-02	3.262e-02
LA	0.000e+00	3.125e-02	2.976e-02	2.922e-02	2.894e-02	2.879e-02	2.872e-02	2.867e-02	2.863e-02	2.861e-02	2.859e-02	2.857e-02
CE	0.000e+00	9.014e-02	7.738e-02	7.250e-02	6.692e-02	6.362e-02	6.137e-02	5.970e-02	5.842e-02	5.742e-02	5.663e-02	5.591e-02
PR	0.000e+00	1.656e-02	1.940e-02	2.193e-02	2.398e-02	2.472e-02	2.509e-02	2.529e-02	2.542e-02	2.550e-02	2.557e-02	2.563e-02
NC	0.000e+00	6.113e-02	6.827e-02	7.117e-02	7.427e-02	7.603e-02	7.803e-02	7.935e-02	8.020e-02	8.094e-02	8.152e-02	8.203e-02
PM	0.000e+00	7.113e-03	5.257e-03	9.577e-03	9.083e-03	8.483e-03	7.900e-03	7.383e-03	6.917e-03	6.491e-03	6.102e-03	5.703e-03
SM	0.000e+00	1.200e-02	1.448e-02	1.540e-02	1.660e-02	1.749e-02	1.821e-02	1.882e-02	1.935e-02	1.982e-02	2.024e-02	2.067e-02
RU	0.000e+00	2.552e-03	2.549e-03	2.617e-03	2.673e-03	2.690e-03	2.697e-03	2.696e-03	2.693e-03	2.688e-03	2.681e-03	2.674e-03
GC	0.000e+00	5.592e-04	8.751e-04	1.447e-03	1.218e-03	1.306e-03	1.379e-03	1.436e-03	1.481e-03	1.521e-03	1.554e-03	1.574e-03
SLMTCY	0.000e+00	9.597e-01	9.996e-01	9.996e-01	9.996e-01	9.996e-01	9.996e-01	9.996e-01	9.996e-01	9.996e-01	9.996e-01	9.996e-01
TOTAL	0.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00	1.000e+00

APPENDIX I:

Verification Testing

This appendix provides documentation of the verification procedures used to assure that the ORIGEN2 code was running properly on the AFIT SSC system, particularly after being modified as described in Section III. Included in the ORIGEN2 files are a sample problem and the resultant output data. It is a fairly involved example, as evidenced by the command file shown on pages 86 through 89. The generated output, if printed, would fill over 400 pages. Ordinarily, the UNIX *diff* utility can be used to compare two files and report any differences; however, the sample results files supplied by ORNL have column 1 removed, thereby negating *diff*'s usefulness in comparing the SSC results to the ORNL results. Instead, the actinide and fission product concentrations, as shown on pages 90 and 91, were checked manually and were found to be in exact agreement with one another. An additional one hundred data points were chosen at random and tested with no differences noted. The discharge actinide compositions of each reactor type studied were also verified through comparison to tables appearing in the appropriate references (6:62; 3:16; 4:30,31; 5:30,31).

92 1 0.99

94 1 0.994

-1

5 1 0.1

-1

2 15

-1

BAS ONE METRIC TON OF PWRU FUEL

RCA -1 = FRESH U FUEL WITH IMPURITIES (1 MT)

RCA -2 = FRESH ZIRCALOY COMPOSITION (1 KG)

RCA -3 = FRESH SS 304 COMPOSITION (1 KG)

RCA -4 = FRESH SS 302 COMPOSITION (1 KG)

RCA -5 = FRESH INCONEL COMPOSITION (1 KG)

RCA -6 = FRESH MICROBRAZE COMPOSITION (1 KG)

RCA WARNING: VECTORS ARE OFTEN CHANGED WITH RESPECT TO THEIR CONTENT.

RCA THESE CHANGES WILL BE NOTED ON RDA CARDS.

CUT 5 0.01 -1

LIP 1 1 1

LPU 380900 551370 -1

LPU 010030 060140 -1

LPU 902320 -1

LPU 380900 -1

LIB 0 1 2 -3 -204 -205 -206 9 3 -2 1 1

PHD 101 102 103 10

OPTL -1 24*8

TIT INITIAL COMPOSITIONS OF UNIT AMOUNTS OF FUEL AND STRUCT MAT'LS

RCA READ FUEL COMPOSITION INCLUDING IMPURITIES (1000 KG)

INP -1 1 -1 -1 1 1

RCA READ ZIRCALOY COMPOSITION (1.0 KG)

INP -2 1 -1 -1 1 1

RCA READ SS304 COMPOSITION (1.0 KG)

INP -3 1 -1 -1 1 1

RCA READ INCONEL 718 COMPOSITION (1.0 KG)

INP -5 1 -1 -1 1 1

RCA READ MICROBRAZE 50 COMPOSITION (1.0 KG)

INP -6 1 -1 -1 1 1

TIT IRRADIATION OF ONE METRIC TON OF PWRU FUEL

MOV -1 1 0 1.0

MEC 1

SLP

IRP 26.7 37.500 1 2 4 2 END OF THIS STEP=1,000 MWD/MTIMM

IRP 66.7 37.500 2 3 4 0 END OF THIS STEP=2,500 MWD/MTIMM

IRP 133.3 37.500 3 4 4 0 END OF THIS STEP=5,000 MWD/MTIMM

IRP 266.7 37.500 4 5 4 0 END OF THIS STEP=10,000 MWD/MTIMM

IRP 400.0 37.500 5 6 4 0 END OF THIS STEP=15,000 MWD/MTIMM

IRP 440.0 37.500 6 7 4 0 END OF THIS STEP=16,500 MWD/MTIMM

IRP 533.3 37.500 7 8 4 0 END OF THIS STEP=20,000 MWD/MTIMM

IRP 666.7 37.500 8 9 4 0 END OF THIS STEP=25,000 MWD/MTIMM

IRP 733.3 37.500 9 10 4 0 END OF THIS STEP=27,500 MWD/MTIMM

IRP 800.0 37.500 10 11 4 0 END OF THIS STEP=30,000 MWD/MTIMM

IRP 880.0 37.500 11 12 4 0 END OF THIS STEP=33,000 MWD/MTIMM

SLP

OPTL 8 8 8 8 7 8 1 2 3 4 5 6 7 8 9 10 11 12

OPTA 8 8 8 8 7 8 1 2 3 4 5 6 7 8 9 10 11 12

OPTF 8 8 8 8 7 8 1 2 3 4 5 6 7 8 9 10 11 12

CUT 12 1 -1 0

ADR

CHARGE

ADR

```

RCA      -10 = IRRADIATED U FUEL AT DISCHARGE
MCV      12 -10 0 1.0
RCA      THESE INSTRUCTIONS ARE HERE ONLY TO DEMONSTRATE THEIR USE
KEC      10 12 1 2 3 -1.0
FAC      1 1 12 4 0.0
RCA      IRRADIATION OF ZIRCALOY+ INCCNEL + MICROBRAZE 50 AT 100% FLUX
TIT      IRRADIATION OF ZIRCALOY+ INCCNEL + MICROBRAZE 50 AT 100% FLUX
MGV      -2 1 0 223.0 ZIRCALOY
ALD      -5 1 0 12.8 INCCNEL
ACC      -6 1 0 2.6 MICROBRAZE 50
ACC      -3 1 0 9.94 SS 304
MEC      1
IRF      26.7 -1.0 1 2 4 4 END OF THIS STEP = 1,000 MWD/MTIHM
IRF      66.7 -1.0 2 3 4 0 END OF THIS STEP = 2,500 MWD/MTIHM
IRF      133.3 -1.0 3 4 4 0 END OF THIS STEP = 5,000 MWD/MTIHM
IRF      266.7 -1.0 4 5 4 0 END OF THIS STEP = 10,000 MWD/MTIHM
IRF      400.0 -1.0 5 6 4 0 END OF THIS STEP = 15,000 MWD/MTIHM
IRF      440.0 -1.0 6 7 4 0 END OF THIS STEP = 16,500 MWD/MTIHM
IRF      533.3 -1.0 7 8 4 0 END OF THIS STEP = 20,000 MWD/MTIHM
IRF      666.7 -1.0 8 9 4 0 END OF THIS STEP = 25,000 MWD/MTIHM
IRF      733.3 -1.0 9 10 4 0 END OF THIS STEP = 27,500 MWD/MTIHM
IRF      800.0 -1.0 10 11 4 0 END OF THIS STEP = 30,000 MWD/MTIHM
IRF      880.0 -1.0 11 12 4 0 END OF THIS STEP = 33,000 MWD/MTIHM
OLT      12 1 -1 0
RCA      -2 = FRESH ZIRCALOY, INCCNEL, AND MICROBRAZE
RCA      -9 = IRRADIATED ZIRCALOY, INCCNEL, AND MICROBRAZE
MCV      1 -2 0 1.0
MCV      12 -9 0 1.0
PCM      -1 -1 -1
PCM      -10 -10 -10
PCM      -2 -2 -2
PCM      -9 -9 -9
STP      2
2 922340 290.0 922350 32000.0 922380 967710.0 0 0.0 FUEL ACTINIDES
4 030000 1.0 050000 1.0 060000 89.4 070000 25.0 FUEL IMPUR
4 080000 134454.0 090000 10.7 110000 15.0 120000 2.0 FUEL IMPUR
4 130000 16.7 140000 12.1 150000 35.0 170000 5.3 FUEL IMPUR
4 200000 2.0 220000 1.0 230000 3.0 240000 4.0 FUEL IMPUR
4 250000 1.7 260000 18.0 270000 1.0 280000 24.0 FUEL IMPUR
4 290000 1.0 300000 40.3 420000 10.0 470000 0.1 FUEL IMPUR
4 480000 25.0 490000 2.0 500000 4.0 640000 2.5 FUEL IMPUR
4 740000 2.0 820000 1.0 830000 0.4 0 0.0 FUEL IMPUR
0
4 400000 979.11 500000 16.0 260000 2.25 240000 1.25 ZIRC-4
4 280000 0.02 130000 0.024 050000 0.00033 480000 0.00025 ZIRC-4
4 060000 0.120 270000 0.010 290000 0.020 720000 0.076 ZIRC-4
4 010000 0.013 250000 0.020 070000 0.080 080000 0.950 ZIRC-4
4 160000 0.035 220000 0.020 740000 0.020 230000 0.020 ZIRC-4
5 920000 0.0002 0 0.0 ZIRC-4
0
4 260000 688.45 240000 190.0 280000 90.0 250000 20.0 SS-304
4 060000 0.8 150000 0.45 160000 0.3 140000 10.0 SS-304
4 070000 1.3 270000 0.8 0 0.0 SS-304
0
4 260000 180.0 240000 190.0 280000 525.0 130000 6.0 INC-718
4 060000 0.4 270000 4.7 290000 1.0 250000 2.0 INC-718

```

ADR

AD-A194 617

USING ORIGEN2 TO PREDICT NUCLEAR REACTOR FUEL
COMPOSITIONS(U) AIR FORCE INST OF TECH WRIGHT-PATTERSON
AFB OH SCHOOL OF ENGINEERING B A LINDBLOM MAR 88

2/2

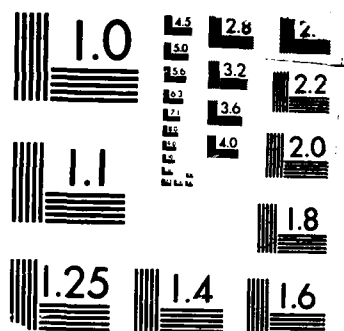
UNCLASSIFIED

AFIT/GNE/ENP/88M-6

F/G 18/10

NL





MICROCOPY RESOLUTION TEST CHART
NBS 1963-A

88

DEC	3.0	4	2	5	0
DEC	10.0	2	3	5	0
DEC	30.0	3	4	5	0
DEC	100.0	4	5	5	0
DEC	300.0	5	6	5	0
DEC	1.0	6	7	7	0
DEC	3.0	7	8	7	0
DEC	10.0	8	9	7	0
DEC	30.0	9	10	7	0
DEC	100.0	10	11	7	0
DEC	300.0	11	-4	7	0
DEC	1.0	-4	12	8	0
OUT	12 1 -1 0				
OUT	-12 1 -1 0				
END					

ADR
ADR

OUTPUT UNIT = 8

PAGE 109

IRRADIATION OF ONE METRIC TON OF PWRU FUEL

POWER= 3.75000e+01 MW, BURNUP= 3.30000e+04 MWD, FLUX= 3.24e+14 N/CM^2-SEC
 5 SUMMARY TABLE: CONCENTRATIONS, GRAMS
 ONE METRIC TON OF PWRU FUEL

CHARGE	26.7D	66.7D	133.3D	266.7D	400.0C	440.0D	533.3D	666.7D	733.3C	800.0D	880.0D
U235	3.200e+04	3.083e+04	2.916e+04	2.658e+04	2.202e+04	1.808e+04	1.700e+04	1.467e+04	1.174e+04	1.044e+04	9.248e+03
U238	9.677e+05	9.671e+05	9.661e+05	9.645e+05	9.612e+05	9.579e+05	9.543e+05	9.506e+05	9.436e+05	9.366e+05	9.441e+05
SURIC7	9.997e+05	9.579e+05	9.923e+05	9.911e+05	9.833e+05	9.760e+05	9.738e+05	9.690e+05	9.623e+05	9.591e+05	9.559e+05
TOTAL	1.000e+06	9.590e+05	9.974e+05	9.948e+05	9.845e+05	9.829e+05	9.793e+05	9.742e+05	9.716e+05	9.690e+05	9.660e+05

OUTPUT UNIT = 8

PAGE 110

IRRADIATION OF ONE METRIC TON OF PWRU FUEL

POWER= 3.75000e+01 MW, BURNUP= 3.30000e+04 MWD, FLUX= 3.24e+14 N/CM^2-SEC
 5 SUMMARY TABLE: CONCENTRATIONS, GRAMS
 ONE METRIC TON OF PWRU FUEL

CHARGE	26.7D	66.7D	133.3D	266.7D	400.0C	440.0D	533.3D	666.7D	733.3C	800.0D	880.0D
U	1.000e+06	9.584e+05	9.961e+05	9.924e+05	9.853e+05	9.787e+05	9.722e+05	9.660e+05	9.629e+05	9.599e+05	9.562e+05
SURIC7	1.000e+06	9.584e+05	9.961e+05	9.924e+05	9.853e+05	9.787e+05	9.722e+05	9.660e+05	9.629e+05	9.599e+05	9.562e+05
TOTAL	1.000e+06	9.590e+05	9.974e+05	9.948e+05	9.845e+05	9.829e+05	9.793e+05	9.742e+05	9.716e+05	9.690e+05	9.660e+05

CUMULATIVE TABLE TOTALS

AP&FP	1.348e+05	1.248e+05	1.348e+05	1.348e+05	1.348e+05	1.348e+05	1.348e+05	1.348e+05	1.348e+05	1.348e+05	1.348e+05
ACT+FP	1.000e+06	9.590e+05	9.974e+05	9.948e+05	9.845e+05	9.829e+05	9.793e+05	9.742e+05	9.716e+05	9.690e+05	9.660e+05
AP&ACT+FP	1.135e+06	1.134e+06	1.132e+06	1.130e+06	1.124e+06	1.119e+06	1.114e+06	1.109e+06	1.106e+06	1.104e+06	1.101e+06

IRRADIATION OF ONE METRIC TON OF PURE FUEL

FISSION PRODUCTS

POWER= 3.75000E+01 MW, BURNUP= 3.30000E+04 MWD, FLUX= 3.24E+14 N/CM^2-SEC
 5 SUMMARY TABLE: CONCENTRATIONS, GRAMS
 ONE METRIC TON OF PURE FUEL

CHARGE	26.70	66.70	133.30	266.70	400.00	440.00	533.30	666.70	733.30	800.00	880.00
SR 88	0.000E+00	1.372E+01	3.387E+01	6.594E+01	1.258E+02	1.409E+02	1.967E+02	2.799E+02	3.026E+02	3.244E+02	3.496E+02
SR 89	0.000E+00	1.922E+01	2.917E+01	3.320E+01	4.163E+01	3.317E+01	3.849E+01	3.374E+01	3.268E+01	3.154E+01	3.011E+01
SR 89	0.000E+00	2.571E+00	3.553E+01	4.767E+01	1.237E+02	1.983E+02	2.102E+02	2.878E+02	3.325E+02	3.628E+02	3.922E+02
SR 90	0.000E+00	2.219E+01	5.448E+01	1.055E+02	1.995E+02	2.858E+02	3.102E+02	3.646E+02	4.367E+02	5.030E+02	5.799E+02
Y 91	0.000E+00	1.513E+01	3.839E+01	5.511E+01	6.045E+01	5.643E+01	5.761E+01	5.019E+01	5.161E+01	4.869E+01	4.624E+01
ZR 91	0.000E+00	3.196E+00	1.733E+01	5.98E+01	1.485E+02	2.386E+02	2.711E+02	3.337E+02	4.186E+02	5.077E+02	6.299E+02
ZR 92	0.000E+00	2.566E+01	5.839E+01	1.145E+02	2.098E+02	3.499E+02	4.156E+02	5.052E+02	5.483E+02	5.904E+02	6.394E+02
ZR 93	0.000E+00	2.542E+01	6.379E+01	1.258E+02	2.443E+02	3.891E+02	4.633E+02	5.650E+02	6.141E+02	6.621E+02	7.182E+02
ZR 94	0.000E+00	2.529E+01	6.283E+01	1.240E+02	2.426E+02	3.569E+02	4.677E+02	5.751E+02	6.277E+02	6.796E+02	7.409E+02
ZR 95	0.000E+00	2.506E+01	6.699E+01	1.218E+02	2.418E+02	3.501E+02	4.601E+02	5.685E+02	6.177E+02	6.791E+02	7.409E+02
PO 95	0.000E+00	5.317E+01	6.484E+00	3.361E+01	1.300E+02	2.590E+02	2.798E+02	3.401E+02	4.716E+02	5.252E+02	5.775E+02
ZR 96	0.000E+00	2.439E+01	6.572E+01	1.302E+02	2.565E+02	3.792E+02	4.156E+02	4.993E+02	6.166E+02	6.743E+02	7.315E+02
PO 97	0.000E+00	2.410E+01	6.174E+01	1.239E+02	2.470E+02	3.680E+02	4.048E+02	4.974E+02	6.051E+02	6.633E+02	7.212E+02
PC 98	0.000E+00	2.530E+01	6.333E+01	1.265E+02	2.528E+02	3.779E+02	4.154E+02	5.027E+02	6.271E+02	6.930E+02	7.510E+02
TC 99	0.000E+00	2.429E+01	6.143E+01	1.258E+02	2.513E+02	3.725E+02	4.079E+02	4.887E+02	6.001E+02	6.537E+02	7.080E+02
PO100	0.000E+00	2.781E+01	6.979E+01	1.399E+02	2.808E+02	4.218E+02	4.641E+02	5.693E+02	7.040E+02	7.745E+02	8.451E+02
CU101	0.000E+00	2.205E+01	5.793E+01	1.162E+02	2.336E+02	3.521E+02	3.863E+02	4.685E+02	5.856E+02	6.439E+02	7.022E+02
RU102	0.000E+00	1.586E+01	5.036E+01	1.025E+02	2.113E+02	3.247E+02	3.597E+02	4.427E+02	5.431E+02	6.278E+02	7.100E+02
RU103	0.000E+00	1.222E+01	3.648E+01	3.448E+01	1.923E+02	3.247E+02	3.597E+02	4.427E+02	5.431E+02	6.278E+02	7.100E+02
RU104	0.000E+00	3.648E+01	1.567E+01	4.728E+01	1.222E+02	1.971E+02	2.184E+02	2.666E+02	3.303E+02	3.592E+02	3.862E+02
PO105	0.000E+00	5.078E+00	2.614E+01	5.403E+01	2.428E+02	2.023E+02	2.271E+02	2.876E+02	3.802E+02	4.288E+02	4.792E+02
PD105	0.000E+00	5.078E+00	1.462E+01	3.328E+01	1.885E+01	1.324E+02	1.497E+02	1.925E+02	2.584E+02	2.532E+02	3.738E+02
TE130	0.000E+00	9.173E+00	2.334E+01	4.771E+01	9.871E+01	1.316E+02	1.678E+02	2.062E+02	2.621E+02	2.505E+02	3.192E+02
KE132	0.000E+00	1.615E+01	3.463E+01	7.372E+01	1.542E+02	2.259E+02	2.458E+02	3.471E+02	3.721E+02	4.218E+02	4.705E+02
KE132	0.000E+00	2.112E+01	6.057E+01	1.287E+02	2.742E+02	4.296E+02	4.781E+02	5.954E+02	7.715E+02	8.628E+02	9.569E+02
CS133	0.000E+00	2.709E+01	8.578E+01	1.820E+02	3.695E+02	5.483E+02	6.008E+02	7.182E+02	8.788E+02	9.550E+02	1.029E+03
KE134	0.000E+00	4.226E+01	1.135E+02	2.264E+02	4.512E+02	6.740E+02	7.408E+02	8.960E+02	1.117E+03	1.227E+03	1.337E+03
CE136	0.000E+00	6.831E+01	1.722E+02	3.599E+02	6.959E+02	1.048E+03	1.150E+03	1.403E+03	1.762E+03	1.942E+03	2.123E+03
CS137	0.000E+00	3.489E+01	9.239E+01	1.846E+02	3.682E+02	5.501E+02	6.045E+02	7.304E+02	9.092E+02	9.979E+02	1.096E+03
RA138	0.000E+00	4.593E+01	1.021E+02	2.028E+02	4.010E+02	5.923E+02	6.532E+02	7.870E+02	9.762E+02	1.070E+03	1.163E+03
LA139	0.000E+00	3.519E+01	9.789E+01	1.945E+02	3.843E+02	5.705E+02	6.258E+02	7.536E+02	9.336E+02	1.023E+03	1.116E+03
BA140	0.000E+00	2.007E+01	2.547E+01	2.581E+01	2.498E+01	2.443E+01	2.442E+01	2.376E+01	2.412E+01	2.402E+01	2.381E+01
CE140	0.000E+00	1.714E+01	7.029E+01	1.469E+02	3.568E+02	5.426E+02	5.993E+02	7.304E+02	9.153E+02	1.008E+03	1.101E+03
CE141	0.000E+00	2.742E+01	4.814E+01	5.930E+01	6.146E+01	6.042E+01	6.052E+01	5.989E+01	5.871E+01	5.880E+01	5.810E+01
PR141	0.000E+00	8.548E+00	4.213E+01	1.803E+02	2.941E+02	4.688E+02	5.175E+02	6.354E+02	8.010E+02	8.918E+02	9.621E+02
CE142	0.000E+00	9.080E+01	9.080E+01	9.080E+01	9.080E+01	9.080E+01	9.080E+01	9.080E+01	9.080E+01	9.080E+01	9.080E+01
PR143	0.000E+00	1.847E+01	2.471E+01	2.524E+01	2.446E+01	2.364E+01	2.309E+01	2.246E+01	2.231E+01	2.208E+01	2.181E+01
ND143	0.000E+00	1.532E+01	2.262E+01	1.462E+02	2.988E+02	4.309E+02	4.670E+02	5.439E+02	6.385E+02	6.793E+02	7.538E+02
CE144	0.000E+00	3.277E+01	7.751E+01	1.413E+02	3.370E+02	5.014E+02	5.442E+02	6.316E+02	7.168E+02	8.012E+02	8.866E+02
ND144	0.000E+00	2.466E+00	8.113E+00	3.166E+01	1.175E+02	2.886E+02	4.026E+02	5.870E+02	8.069E+02	7.920E+02	9.237E+02
ND145	0.000E+00	2.446E+01	6.109E+01	1.204E+02	2.335E+02	3.399E+02	3.707E+02	4.401E+02	5.342E+02	5.790E+02	6.222E+02
ND146	0.000E+00	1.932E+01	4.847E+01	9.719E+01	1.959E+02	2.966E+02	3.274E+02	4.001E+02	5.067E+02	5.812E+02	6.866E+02
PD147	0.000E+00	7.396E+00	2.597E+01	5.511E+01	1.492E+02	2.436E+02	2.744E+02	3.333E+02	4.091E+02	4.509E+02	5.033E+02
ND148	0.000E+00	1.128E+01	2.837E+01	1.130E+02	1.950E+02	1.858E+02	2.249E+02	2.807E+02	3.085E+02	3.363E+02	3.697E+02
SUMTC	0.000E+00	9.112E+02	2.338E+03	4.682E+03	9.323E+03	1.388E+04	1.523E+04	1.836E+04	2.277E+04	2.495E+04	2.711E+04
TOTAL	0.000E+00	1.038E+03	2.600E+03	5.193E+03	1.037E+04	1.532E+04	1.707E+04	2.066E+04	2.578E+04	2.935E+04	3.399E+04

APPENDIX J:

Running ORIGIN2 on the AFIT SSC

These instructions are designed specifically for use with the AFIT Scientific Support Computer, although they will apply in general to any VAX computer with a UNIX operating system. Some portions, such as tape unit designations, are system-dependent and may require modification.

If the user does not already have the ORIGIN2 code on disk or tape, a copy may be obtained, free of charge, by sending a magnetic tape to the following address:

Codes Coordinator
Radiation Shielding Information Center
P.O. Box X
Oak Ridge National Laboratory
Oak Ridge, Tennessee 37830

At the time of this writing, the ORIGIN2 code is being stored at AFIT on tape #2473, available through Lt Col Ronald Tuttle, Department of Engineering Physics.

Once the magnetic tape is received, the code must then be transferred from tape to the user's files on hard-disk. The following is the format of a command file which, when executed, will copy the 70 ORIGIN2 files from tape unit 80 to the user's working directory. To save disk space, copy only those files that are needed for the case(s) being run and keep them compressed when not in use.

```

#
echo 1
dd if=/dev/nrmt9 of=01 ibs=3200 cbs=80 obs=80 conv=unblock
compress 01
.
.
.
echo 63
dd if=/dev/nrmt9 of=63 ibs=3200 cbs=80 obs=80 conv=unblock
compress 63
echo 64
dd if=/dev/nrmt9 of=64 ibs=2600 cbs=133 obs=133 conv=unblock
compress 64
.
.
.
echo 70
dd if=/dev/nrmt9 of=70 ibs=2600 cbs=133 obs=133 conv=unblock
compress 70

```

To copy a single file from tape, ensure that the tape is rewound and use the following command file:

```

#
@ file= [File number to be copied]
echo $file
mt -f /dev/nrmt9 fsf [File number - 1]
dd if=/dev/nrmt9 of=$file ibs=3200 cbs=80 obs=80 conv=unblock

```

OR, if appropriate:

```
dd if=/dev/nrmt9 of=$file ibs=2600 cbs=133 obs=133 conv=unblock
```

The changes described on pages *vii* through *xii* of CCC-371 (supplied by ORNL as part of the ORIGEN2 package) and in Section III of this paper must be made to allow the code to run on the SSC.

When compiling the executable portion of the code, use of the *-w* option is recommended to suppress numerous warning messages which result from the

code's use of Hollerith variables and unused variable declarations. Also, each file must have a .f extender, as in the following example, to be recognized as a FORTRAN program by the f77 compiler:

```
f77 -w 03.f 19.f -o ORIGEN2.out
```

The following input files must be created before running the compiled program:

TAPE5.INP: ORIGEN2 command file

TAPE3.INP: Substitute data cards for decay and cross section libraries (if none, then this is a dummy file)

TAPE4.INP: Dummy file

TAPE9.INP: File made up of decay library (file 21) with the appropriate cross section library appended to it

TAPE10.INP: Photon library (file 61, 62, or 63)

If the user desires to run the program while not interactively logged-in to the system, the following command will allow the program to continue running in background after logging out:

```
nohup ORIGEN2.out &
```

Refer to CCC-371 for details on what types of output are written to each output file.

Bibliography

1. Croff, Allen G. *A User's Manual for the ORIGEN2 Computer Code*. Oak Ridge National Laboratory report TM-7175. Oak Ridge TN, 1980.
2. Croff, Allen G. "ORIGEN2: A Versatile Computer Code for Calculating the Nuclide Compositions and Characteristics of Nuclear Materials," *Nuclear Technology*, 62: 335-353 (September 1983).
3. Croff, Allen G. and M. A. Bjerke. *Alternate Fuel Cycle PWR Models for the ORIGEN Computer Code*. Oak Ridge National Laboratory report TM-7005. Oak Ridge TN, 1980.
4. Croff, Allen G. and M. A. Bjerke. *Once-Through CANDU Reactor Models for the ORIGEN2 Computer Code*. Oak Ridge National Laboratory report TM-7177. Oak Ridge TN, 1980.
5. Croff, Allen G. et al. *LMFBR Models for the ORIGEN2 Computer Code*. Oak Ridge National Laboratory report TM-7176/R1. Oak Ridge TN, 1983.
6. Croff, Allen G. et al. *Revised Uranium-Plutonium Cycle PWR and BWR Models for the ORIGEN Computer Code*. Oak Ridge National Laboratory report TM-6051. Oak Ridge TN, 1978.
7. Department of the Air Force. *Air Force Technical Applications Center*. Public Affairs release. Patrick AFB FL, undated.
8. Eisenbud, Merril. *Environmental Radioactivity* (Third Edition). Orlando FL: Academic Press, 1987.
9. Radiation Shielding Information Center. *ORIGEN2 Isotope Generation and Depletion Code - Matrix Exponential Method*. RSIC report CCC-371. Oak Ridge TN, 1986.

Vita

Captain Bruce A. Lindblom was born on 13 April 1956 in Toledo, Ohio. He graduated from high school in Chillicothe, Missouri, in 1974 and attended the University of Missouri-Columbia for two semesters. He then entered the United States Air Force Academy and received a Bachelor of Science degree in Physics and a commission in the Air Force in May 1979. Upon completion of pilot training in October 1980, he was assigned to Pope AFB, North Carolina, where he served as a C-130 pilot, instructor pilot, and flight examiner. Captain Lindblom began his studies in graduate nuclear science at the School of Engineering, Air Force Institute of Technology, in September 1986.

Permanent address: 5 Cricket Square
50 Woodside Road
Ardmore, Pennsylvania 19003

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

A111617

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT SECURITY CLASSIFICATION UNCLASSIFIED		1b. RESTRICTIVE MARKINGS	
2a. SECURITY CLASSIFICATION AUTHORITY		3. DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release; distribution unlimited	
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE			
4. PERFORMING ORGANIZATION REPORT NUMBER(S) AFIT/GNE/ENP/88M-6		5. MONITORING ORGANIZATION REPORT NUMBER(S)	
6a. NAME OF PERFORMING ORGANIZATION School of Engineering	6b. OFFICE SYMBOL (If applicable) AFIT/ENP	7a. NAME OF MONITORING ORGANIZATION	
6c. ADDRESS (City, State, and ZIP Code) Air Force Institute of Technology Wright-Patterson AFB OH 45433-6583		7b. ADDRESS (City, State, and ZIP Code)	
8a. NAME OF FUNDING / SPONSORING ORGANIZATION	8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER	
8c. ADDRESS (City, State, and ZIP Code)		10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. PROJECT NO. TASK NO. WORK UNIT ACCESSION NO.	
11. TITLE (Include Security Classification) See Box 19			
12. PERSONAL AUTHOR(S) Bruce A. Lindblom, B.S., Captain, USAF			
13a. TYPE OF REPORT MS Thesis	13b. TIME COVERED FROM _____ TO _____	14. DATE OF REPORT (Year, Month, Day) 1988 March	15. PAGE COUNT 105
16. SUPPLEMENTARY NOTATION <i>from the side</i>			
17. COSATI CODES FIELD GROUP SUB-GROUP 18 09		18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number) Actinide Series; Fission Products; Heavy Metals; Nuclear Reactors; Nuclides; Reactor Fuels; <i>Theses.</i>	
19. ABSTRACT (Continue on reverse if necessary and identify by block number) Title: USING ORIGEN2 TO PREDICT NUCLEAR REACTOR FUEL COMPOSITIONS Thesis Chairman: Ronald F. Tuttle, Lt Col, USAF Assistant Professor and Deputy Head Department of Engineering Physics <div style="text-align: right;"><i>Approved for public release</i> LAW AFB 180-17 <i>E. E. WOLAVER</i> 18 Jun 88 Dean for Research and Professional Development Air Force Institute of Technology (AFIT) Wright-Patterson AFB OH 45433</div>			
20. DISTRIBUTION / AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS		21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED	
22a. NAME OF RESPONSIBLE INDIVIDUAL Ronald F. Tuttle, Lt Col, USAF		22b. TELEPHONE (Include Area Code) (513) 255-4498	22c. OFFICE SYMBOL AFIT/ENP

→ The purpose of this study was threefold: (1) to modify the ORIGEN2 Isotope Generation and Depletion Code to run on a Digital VAX computer using a UNIX operating system, (2) to establish a data base of nuclear reactor fuel isotopic compositions for selected reactor types and fuel cycles at various times during each fuel cycle, and (3) to determine the uniqueness of the isotopic compositions of the cases studied. The ORIGEN2 code uses a matrix exponential technique to solve the differential equations describing the buildup and decay of nuclides. The user-generated command file and the highly controllable output make ORIGEN2 quite versatile in modeling reactor operations. Modifications required to allow the code to run on a UNIX-based Digital VAX system were confined primarily to one of the integer functions used in reading the command file. Actinide and fission product compositions of irradiated fuel were produced for eight cases representative of modern commercial nuclear reactors. These results include composition by both isotope and element and are expressed in fraction of atoms of each segment (actinide or fission product). Isotopic fuel compositions were shown to be distinctly unique.

Requires Is. → to field ?

END

DATE

FILMED

8-88

DTIC